DENSO ROBOT

**-D/-E SERIES

OPTIONS MANUAL

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Preface

Thank you for purchasing optional devices designed for DENSO robots.

This manual covers the specifications, installation, and use of optional devices to be configured in the **-D/-E series robot system together with the RC5 controller.

Before use, read this manual carefully to safely get the maximum benefit from your robot and options in your assembling operations.

Options covered by this manual

Optional devices designed for robot systems configured with RC5 controller

Important

To ensure operator safety, be sure to read the precautions and instructions in "SAFETY PRECAUTIONS."

To the customer who purchased an extension board as an additional component

If you purchase an extension board requiring the system to enable the extension function with a password, check the password label on the cover of this manual. The password is prepared in relation to the serial number assigned to your robot controller. By using the password, you need to make the system enable the extension function according to the procedure below.

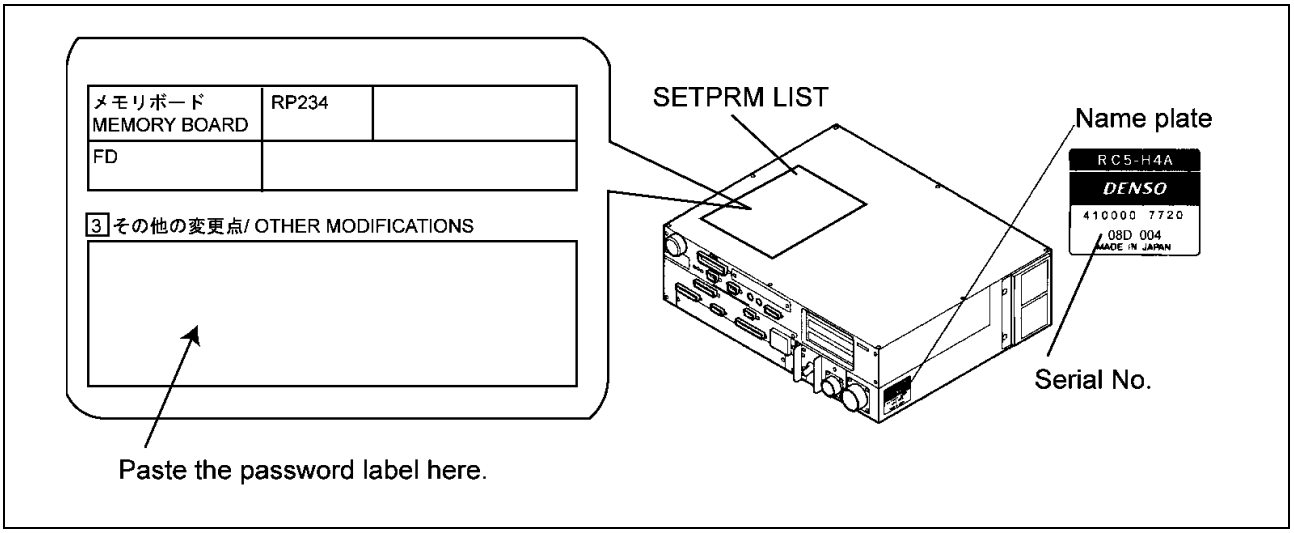
NOTE: If your extension board is installed to any robot controller other than the one whose serial number you informed us of at the time of purchase, the extension function cannot be enabled.

NOTE: If you purchase a robot controller with a built-in extension board, no enabling operation is required since the robot controller is set up with the extension function enabled.

(1) Check that the serial number printed on the password label on the cover of this manual is identical with that of your robot controller.

(2) Remove the password label from this manual and attach it to the OTHER MODIFICATIONS area of the SETPRM LIST on your robot controller.

(3) Enable the extension function of the extension board according to the instructions given on the following pages.

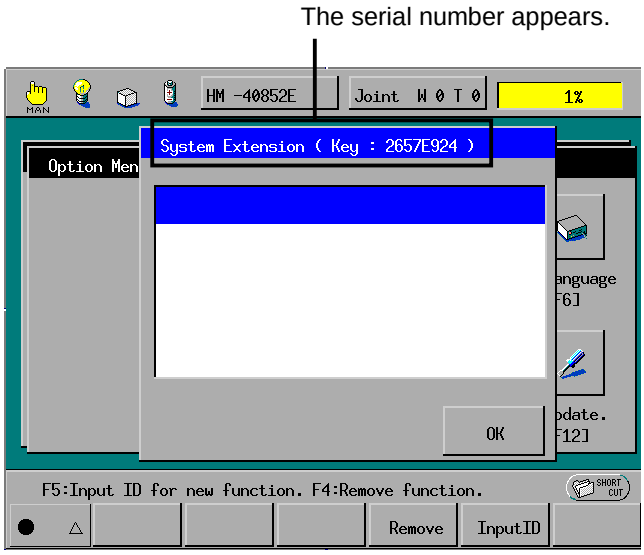


Enabling extension functions by the teach pendant

Access: [F6 Set]—[F7 Options.]—[F8 Extnsion]—[F5 Input ID]

Enables the extension function. Once enabled, the setting will be retained even if the controller power is turned off and on.

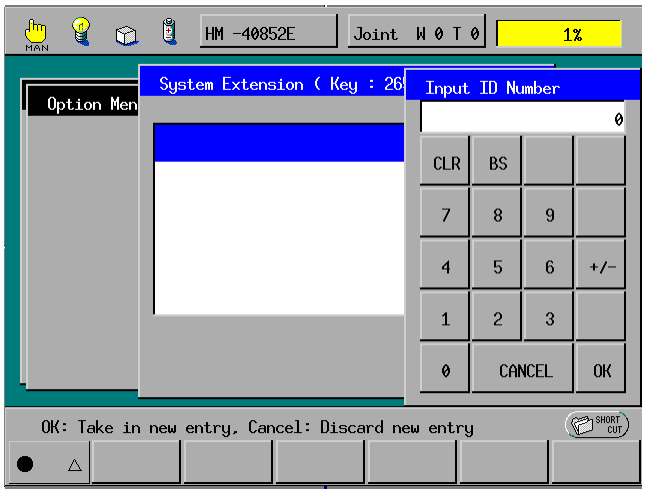
(1) Press [F8 Extnsion] in the Option Menu, and the System Extension window will appear as shown below.



(2) Press [F5 Input ID] on the System Extension window, and the numeric keypad will appear.

(3) Enter the password and press [OK].

The name of the newly added function will be displayed.



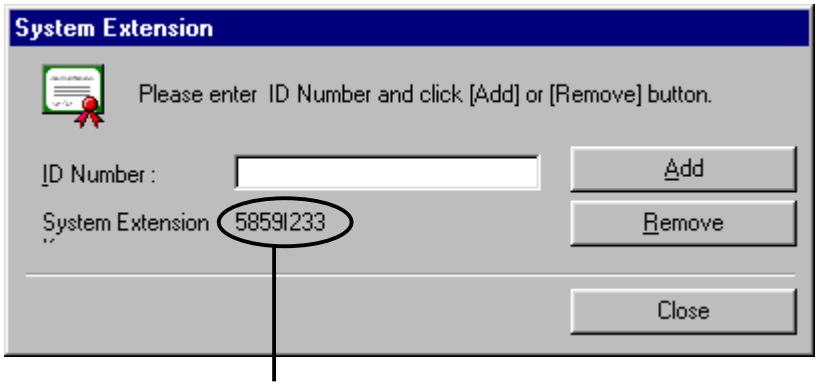
(4) Restart the controller to make the extension function go into effect.

Enabling extension functions in WINCAPSII

Enables the extension function. Once enabled, the setting will be retained even if the controller power is turned off and on.

(1) When WINCAPSII and the controller are in connection, choose the “System Extension” from Help Menu.

(2) The System Extension window appears. Enter the password and press [Add].



The serial number appears.

(3) Restart the controller to make the extension function go into effect.

How the documentation set is organized

The documentation set consists of the following books. If you are unfamiliar with this robot and option(s), please read all books and understand them fully before operating your robot and option(s).

GENERAL INFORMATION ABOUT ROBOT

Provides the packing list of the robot and outlines of the robot system, robot unit, and robot controller.

INSTALLATION & MAINTENANCE GUIDE

Provides instructions for installing the robot components and customizing your robot, and maintenance & inspection procedures.

BEGINNER'S GUIDE

Introduces you to the DENSO robot. Taking an equipment setup example, this book guides you through running your robot with the teach pendant, making a program in WINCAPSII, and running your robot automatically.

SETTING-UP MANUAL

Describes how to set-up or teach your robot with the teach pendant, operating panel, or mini-pendant.

WINCAPSII GUIDE

Provides instructions on how to use the teaching system WINCAPSII which runs on the PC connected to the robot controller for developing and managing programs.

PROGRAMMER'S MANUAL (I), (II)

Describes the PAC programming language, program development, and command specifications in PAC.

RC5 CONTROLLER INTERFACE MANUAL

Describes the RC5 controller, interfacing with external devices, system- and user-input/output signals, and I/O circuits.

ERROR CODE TABLES

List error codes that will appear on the teach pendant, operating panel, or PC screen if an error occurs in the robot series or WINCAPSII. These tables provide detailed description and recovery ways.

OPTIONS MANUAL - this book -

Describes the specifications, installation, and use of optional devices.

How this book is organized

This book is just one part of the robot documentation set. This book consists of chapters 1 through 12.

PART 1 OPTIONAL OPERATION DEVICES

Describes optional operation devices designed for operating your robot.

Chapter 1 Teaching Pendant
Chapter 2 Operating Panel
Chapter 3 Mini-Pendant (In version 1.7 or later)
Chapter 4 PC Teaching System "WINCAPSII"

PART 2 OPTIONAL BOARDS FOR RC5 CONTROLLER

Describes optional boards that can be installed to the RC5 controller. If you place an order for our robot system together with these optional boards, those boards will be built in the RC5 controller at the factory and then the robot system will be delivered.

Chapter 5 Floppy Disk Drive
Chapter 6 μVision Board
Chapter 7 Ethernet Board
Chapter 8 DeviceNet Slave Board
Chapter 9 DeviceNet Master Board
Chapter 10 PROFIBUS-DP Slave Board
Chapter 11 Configuring the RS-232C Extension Board (Recommended Option)
Chapter 12 Mounting Extension Boards

PART 3 OTHER OPTIONS

Describes options except optional operation devices and optional boards.

Chapter 13 Controller Protective Box

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PART 1 OPTIONAL OPERATION DEVICES

Chapter1 Teach Pendant

The teach pendant is an entry/operation device for creating programs and teaching. The teach pendant can perform all operations except automatic external operation.

1.1 Teach Pendant Functions

For instructions on how to operate the teach pendant, refer to the SETTING-UP MANUAL.

Programming and teaching

This function allows you:

- to enter commands and store the robot arm position. You may specify a program and enter program steps one by one,
- to modify, delete, or copy those commands and robot arm positions, and
- to check edited programs in running them in Teach check mode.

Operating the robot

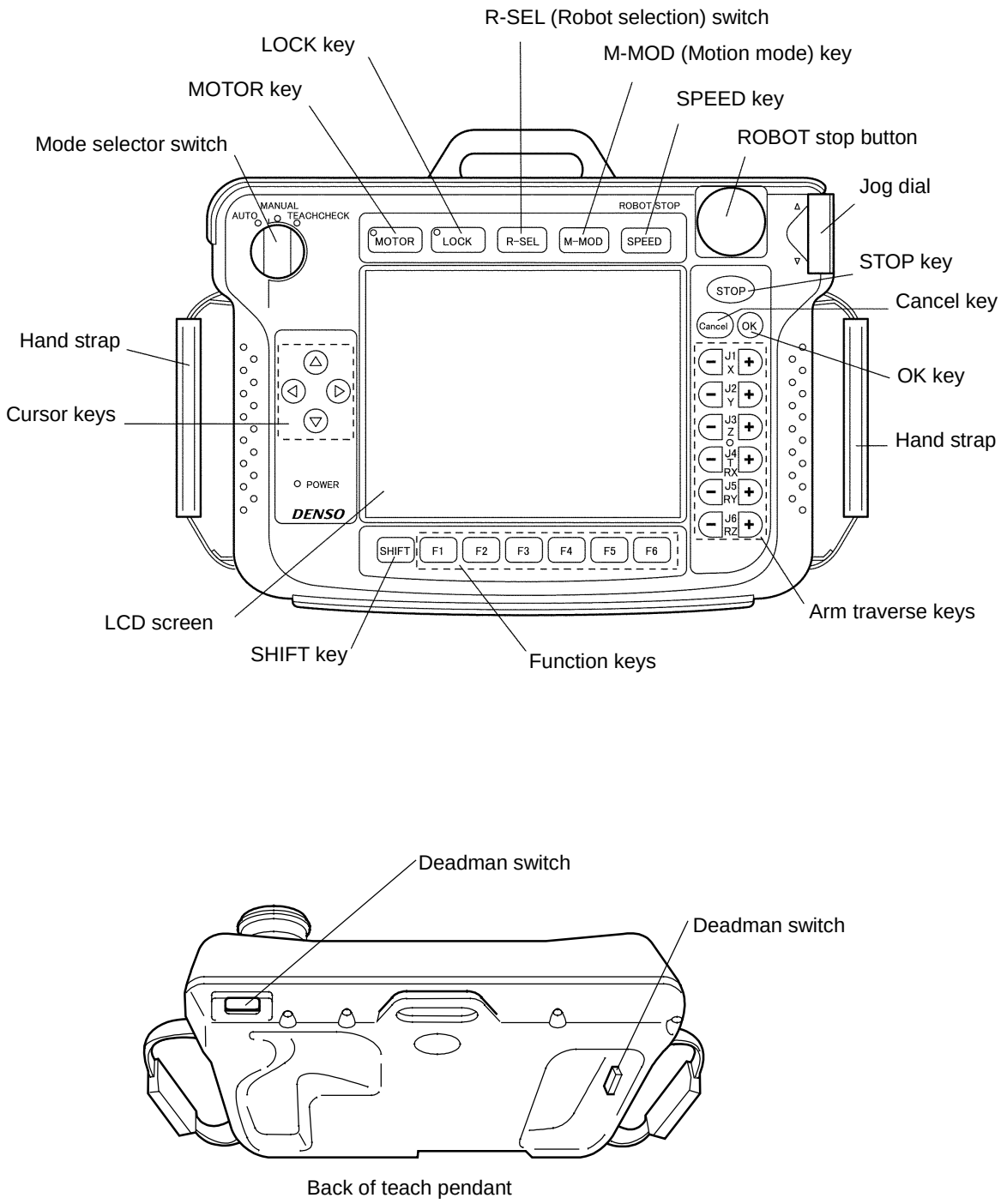
This function turns power to the motor ON/OFF, executes CAL, starts and stops automatic operation, and performs manual operation.

Displaying

This function displays the contents of programs, the progress of running programs, ongoing step number, current robot position or error messages.

1.2 Names of Teach Pendant Components

The figure below shows the names of the teach pendant components.



Names of Teach Pendant Components

1.3 Teach Pendant Specifications

1.3.1 Specifications

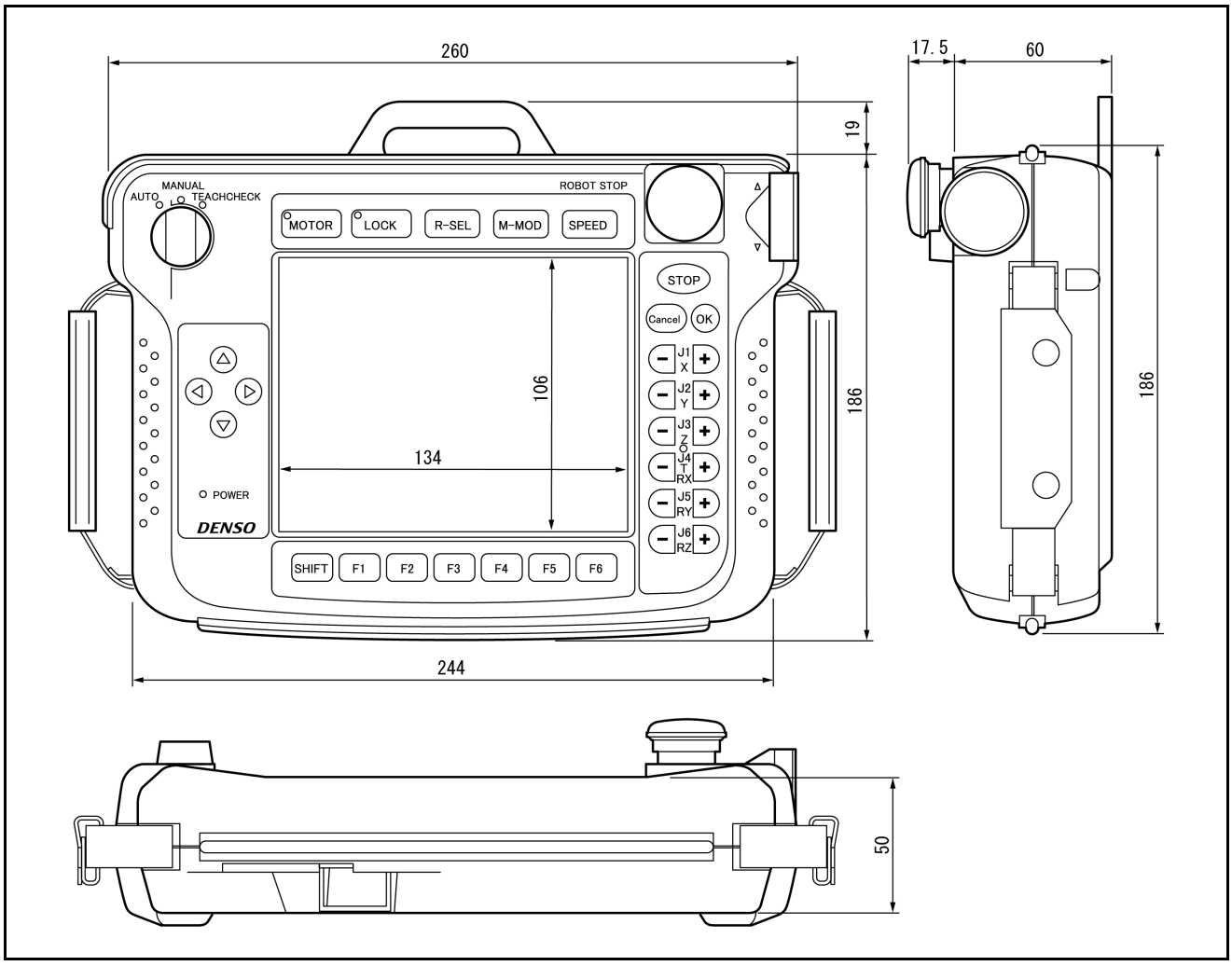
The table below lists the teach pendant specifications.

Teach Pendant Specifications

Item	Specifications
Model	TP-RC5-1
Display	Liquid crystal display with backlight, 640 × 480 pixels
Power source	24 VDC (supplied from robot controller)
Operation	Robot stop button, deadman switch, jog dial, MOTOR power on/off key, AUTO/MANUAL selector switch, function keys, arm traverse keys, LOCK key, R-SEL (robot selection) key, M-MOD (motion mode) key, SPEED key, cursor keys, STOP key, OK key, Cancel key
Installation conditions	Temperature: 0 to 40°C Humidity: 90% RH or less (Dew condensation shall not be allowed.)
Outside dimensions (W x H x D)	260 × 186 × 60 mm (excluding projections)
Weight	1 kg
Cable length	4 m, 8 m, or 12 m

1.3.2 Outer Dimensions

The figure below shows the outer dimensions of the teach pendant.



Outer Dimensions of the Teach Pendant

1.3.3 Pendantless State

What is Pendantless State?

The state without having connected the operating panel and the teach pendant to the robot controller is called a pendantless state.

Setting the Pendantless State

As described below, there are four ways to set the pendantless state:

(1) Turning ON the power to the robot controller without the operating panel and the teach pendant.

(2) Disconnecting the connected teach pendant.

(3) Disconnecting the connected operating panel.

(4) Disconnecting the connected operating panel and teach pendant.

Caution: Refer to the operation procedures described in Subsection 1.3.4 Connecting and Disconnecting Operating Panel and Teach Pendant" on the next page when connecting or disconnecting the operating panel and the teach pendant with the power to the robot controller ON.

Pendantless State Precautions

Since no teach pendant is connected in the Pendantless state, the robot cannot enter the manual operation mode or the teach check mode.

The robot is therefore in the Auto mode whenever the Enable Auto input is free. The external mode cannot be switched, and the program cannot start to run. When operating the robot in the Pendantless state perform the following steps:

(1) Set the robot not to start to operate when the Enable Auto input is free.

(2) Enable Auto input free state and automatic mode output. Refer to the RC5 CONTROLLER INTERFACE MANUAL, Subsections 4.2.2 and 6.2.2, “Auto Mode (Output).”

Set the equipment to make an emergency stop in an AND state.

Add (1) and (2) above to the external sequence circuit.

1.3.4 Connecting and Disconnecting Operating Panel and Teach Pendant

The operating panel and the teach pendant can be connected or disconnected with the power to the robot controller ON. Connect or disconnect them according to the procedure described below.

The table below shows the state of change resulting from connecting or disconnecting the operating panel and/or the teach pendant.

Each letter in the table represents the appropriate connecting and disconnecting procedure (×: no procedure applicable).

Change of State by Connection and Disconnection

Before change / After change	Pendantless mode	OP connected	TP connected	OP and TP connected
Pendantless mode	×	(A)	(B)	(A)
OP connected	(D)	×	×	(C)
TP connected	(D)	×	×	×
OP and TP connected	(D)	(D)	×	×

Caution: The operating panel and the teach pendant cannot be connected or disconnected while a program is being executed.

Connection and Disconnection Procedures

Procedure	Steps
(A)	Step 1 Select the AUTO mode, and activate an emergency stop. Step 2 Disconnect the connector from CN5 on the robot controller. Step 3 Connect the connector used for pendantless operation to CN5 of the robot controller. Step 4 Error 2187 occurs. Clear it from the external device.
(B)	Step 1 Select the AUTO mode, and activate an emergency stop. Step 2 Perform disconnection. See the SETTING-UP MANUAL, Section 5.9, "Preparing the Robot Controller to Unplug the Teach Pendant." Step 3 Disconnect the connector from CN5 on the robot controller within 15 seconds. Step 4 Connect the connector for Pendantless operation to CN5 on the robot controller.
(C)	Step 1 Set the mode selector switch on the operating panel to TP. Step 2 Set the mode selector switch on the teach pendant to AUTO, and activate an emergency stop. Step 3 Perform disconnection. See the SETTING-UP MANUAL, Section 5.9, "Preparing the Robot Controller to Unplug the Teach Pendant." Step 4 Disconnect the teach pendant from the operating panel within 15 seconds. Step 5 Connect the connector used for Pendantless operation to the operating panel. Step 6 Set the mode selector switch on the operating panel to MANUAL.
(D)	Step 1 Disconnect the connector used for pendantless operation from CN5 on the robot controller. Step 2 Connect the operating panel or teach pendant to CN5 on the robot controller.

Chapter2 Operating Panel

The operating panel is a fixed type operation console that allows you to recover the robot from a stop due to problems caused by peripheral units, etc. The panel has minimum necessary teaching/operating functions.

To the operating panel you may connect a teach pendant which is designed for teaching and other fine operations.

The **ROBOT STOP** button and the **STOP** key on the operating panel and the teach pendant are available anytime. For other functions, you may select the operating panel or teach pendant. To switch between the operating panel and teach pendant, use the mode selector switch on the operating panel.

2.1 Operating Panel Functions

Operating

The operating panel provides these functions--motor power ON/OFF, CAL execution, program selection, speed change, automatic operation start/stop and manual operation. For further information, see the SETTING-UP MANUAL.

Display

The operating panel has an LCD capable of displaying 2 lines of 16 characters. It displays the current robot position, ongoing program number, error code when an error occurs, and related information in alphanumerical characters.

Teaching

With the operating panel, you may run the robot manually and start programs. As listed below, you may also edit variables, get robot arm positions into variables in teaching, and move the robot arm by specifying a desired variable, depending upon the version of the main software. Choosing work coordinates or tool coordinates is also possible. For details, refer to the SETTING-UP MANUAL.

Version of main software	Function	Description
Version 1.2 or later	Editing variables	You may edit variables by entering numerical values.
Version 1.4 or later	Teaching the current position	You may get the current position into P variables, J variables, and T variables. It is used for position teaching.
	Choosing work coordinates or tool coordinates	You may choose work coordinates or tool coordinates.
Version 1.6 or later	Operating the robot arm by specifying a desired variable	You may move the robot arm according to the specified variable. It is used to confirm variables you have preset in teaching.

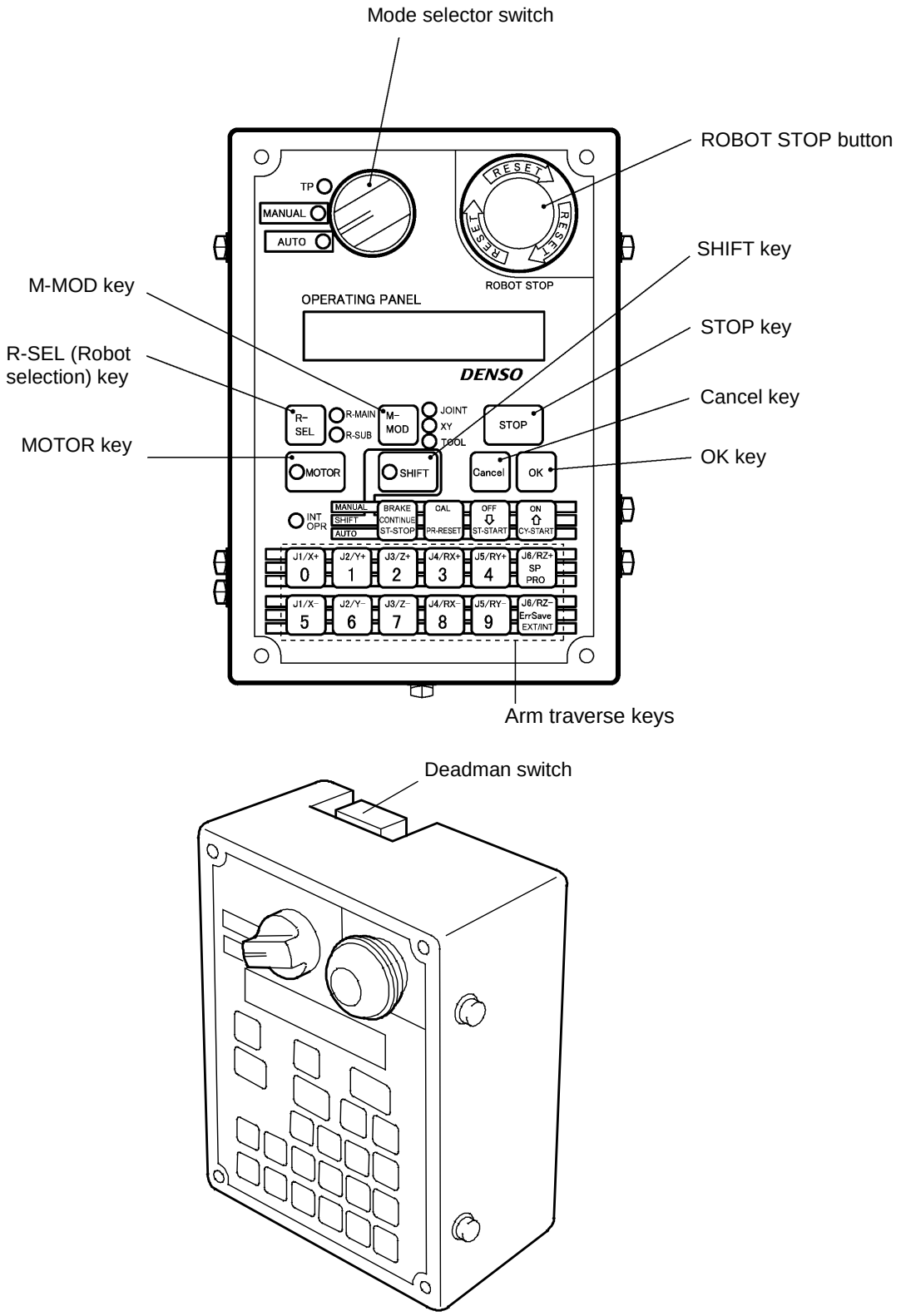
Connecting the Teach Pendant

You may connect the teach pendant to the **TP** terminal at the bottom of the operating panel. Setting the mode selector switch on the operating panel to the **TP** position allows you to operate the robot from the teach pendant.

When the mode selector switch is set to the **MANUAL** or **AUTO** position, the robot is operated from the operating panel.

2.2 Names of Operating Panel Components

The figure below shows the names of the operating panel components.



Names of Operating Panel Components

2.3 Operating Panel Specifications

The table below lists the operating panel specifications.

Operating Panel Specifications

Item	Specifications
Model	OP-RC5-1
Display	Liquid crystal display with backlight, 16 characters × 2 lines
Power source	24 VDC (supplied from robot controller)
Operation	23 flat key switches, ROBOT STOP button, mode selector switch, deadman switch
Installation conditions	Temperature: 0 to 40°C Humidity: 90% RH or less (Dew condensation shall not be allowed.)
Dimensions (H x W x D)	140 × 100 × 40 mm (Excluding projections such as switches)
Weight	Approx. 0.7 kg
Cable length	4 m or 8 m
Others	Equipped with a socket for connecting the teach pendant (See Note.)

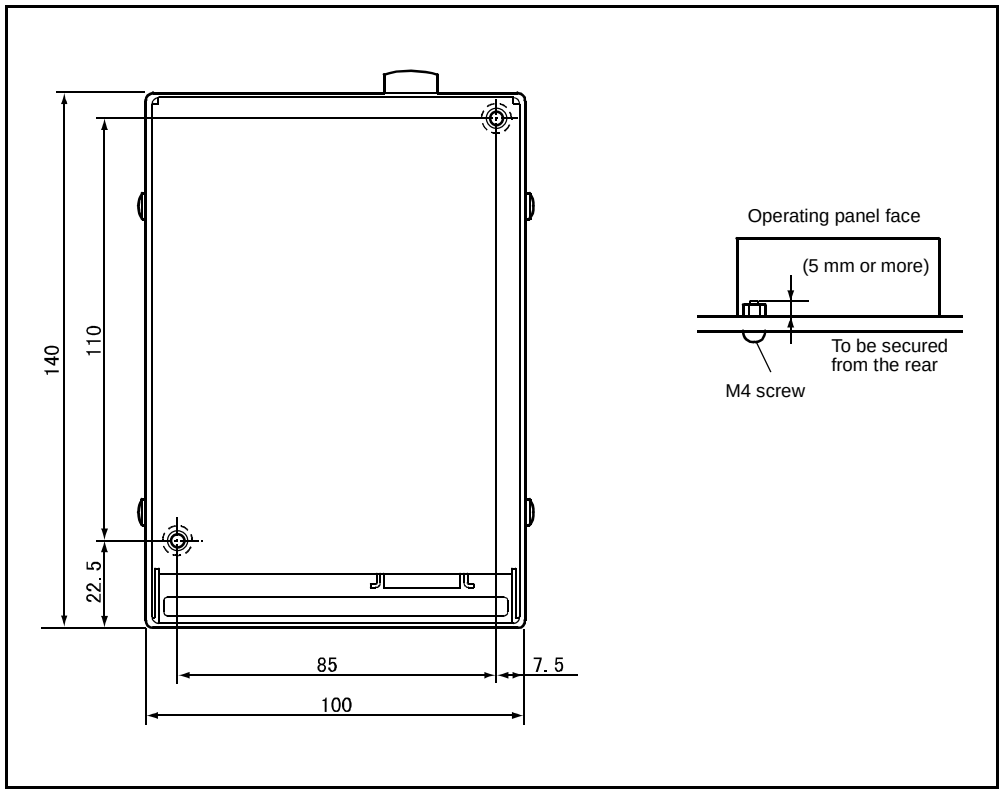
(Note) When no teach pendant is connected, a pendantless connector should be connected to the TP socket.

⚠Caution: The operating panel is a fixed type operation console. Be sure to secure it to the equipment.

2.4 Mounting and Connecting the Operating Panel

Mounting the operating panel

The operating panel is a fixed type operation console. Mount it to the equipment, referring to the figure given below.

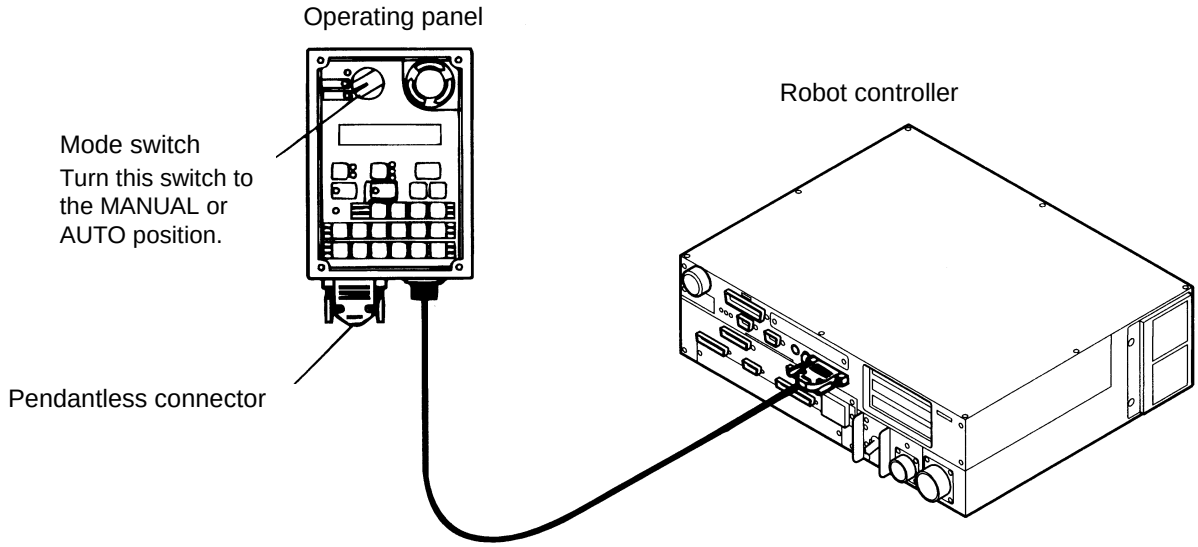


Mounting the Operating Panel

Connecting the operating panel

As shown in the figure given below, the operating panel can be connected to the robot controller. A teach pendant can also be connected to the operating panel.

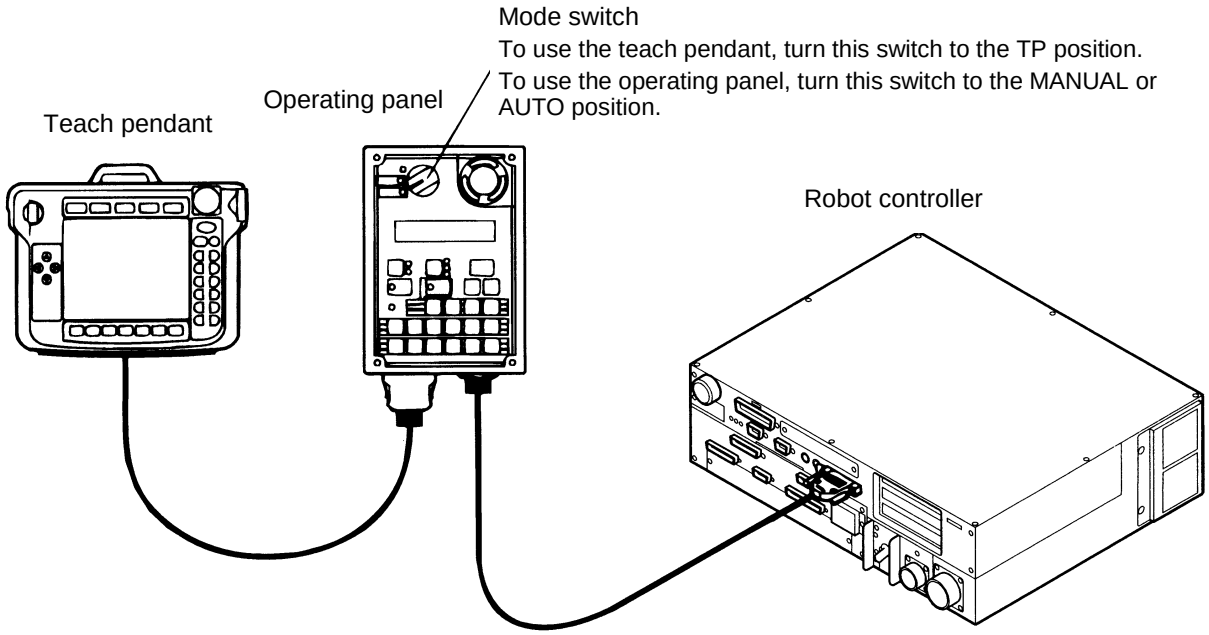
Connection type 1: Operating panel only



NOTE: Be sure to secure the operating panel to a safe place such as equipment.

NOTE: When using the operating panel without the teach pendant connected, always insert the pendantless connector into the TP socket on the operating panel.

Connection type 2: Operating panel connected with the teach pendant


Mode switch
To use the teach pendant, turn this switch to the TP position.
To use the operating panel, turn this switch to the MANUAL or AUTO position.
Operating panel
Teach pendant
Robot controller

NOTE: The total cable length must not be more than 12 m when the operating panel and the teach pendant are to be connected in series.

Connecting the Operating Panel to the Robot Controller and the Teach Pendant

Chapter3 Mini-Pendant (In version 1.7 or later)

The mini-pendant is an entry/operation device for operating the robot manually, starting programs, and teaching. It has no programming function.

Using the mini-pendant together with WINCAPSII or WINCAPSII Light enables efficient programming and teaching.

3.1 Mini-Pendant Functions

For instructions on how to operate the mini-pendant, refer to the SETTING-UP MANUAL.

Teaching

This function allows you to store the robot arm position (limited to editing of P variables and J variables). You can check edited programs in running them step by step.

Operating the robot

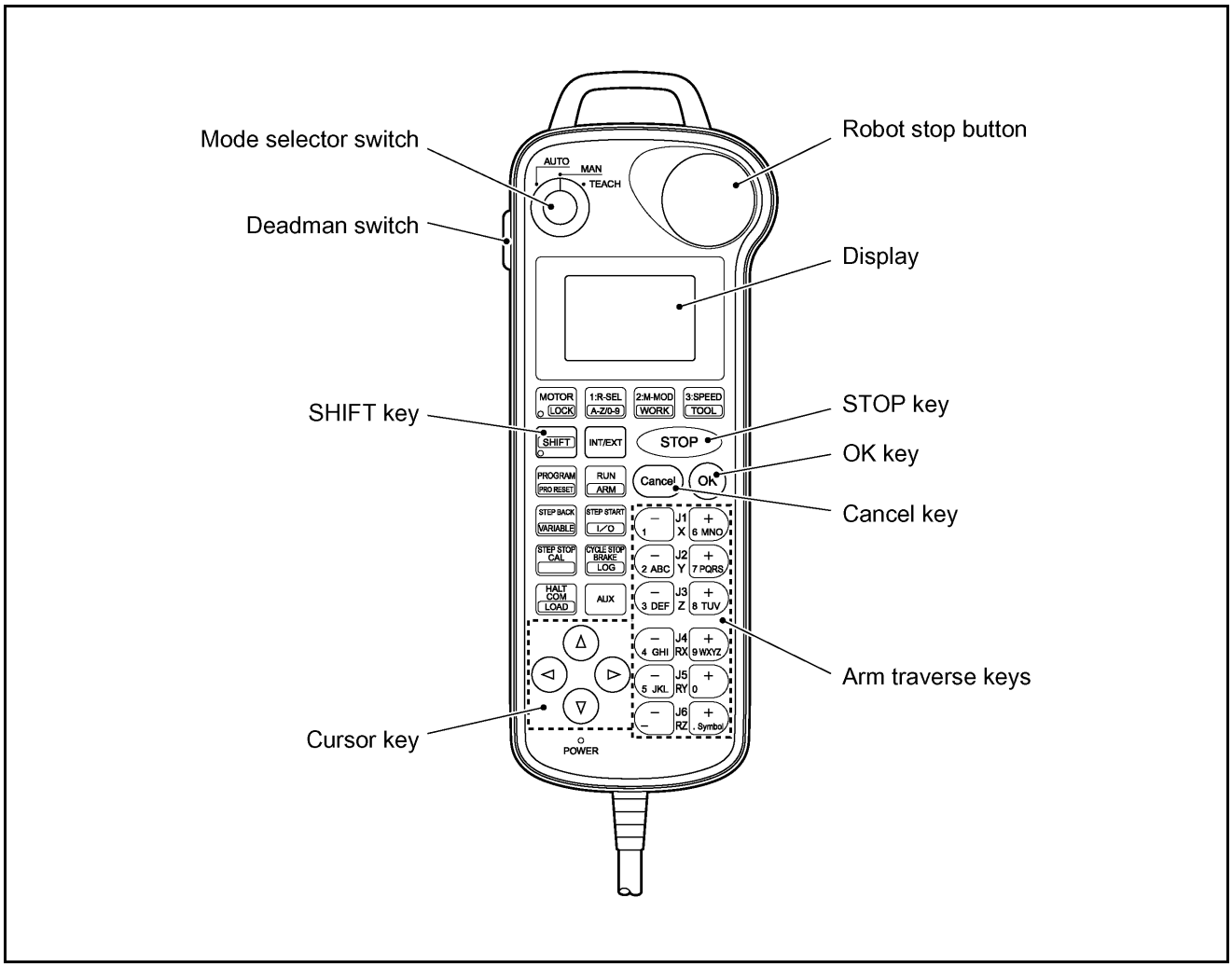
This function turns power to the motor ON/OFF, executes CAL, starts and stops automatic operation, and performs manual operation.

Displaying

This function displays the current robot arm position, running program number, ongoing step number or error codes.

3.2 Names of Mini-Pendant Components

The figure below shows the names of the mini-pendant components.



Names of Mini-Pendant Components

3.3 Mini-Pendant Specifications

3.3.1 Specifications

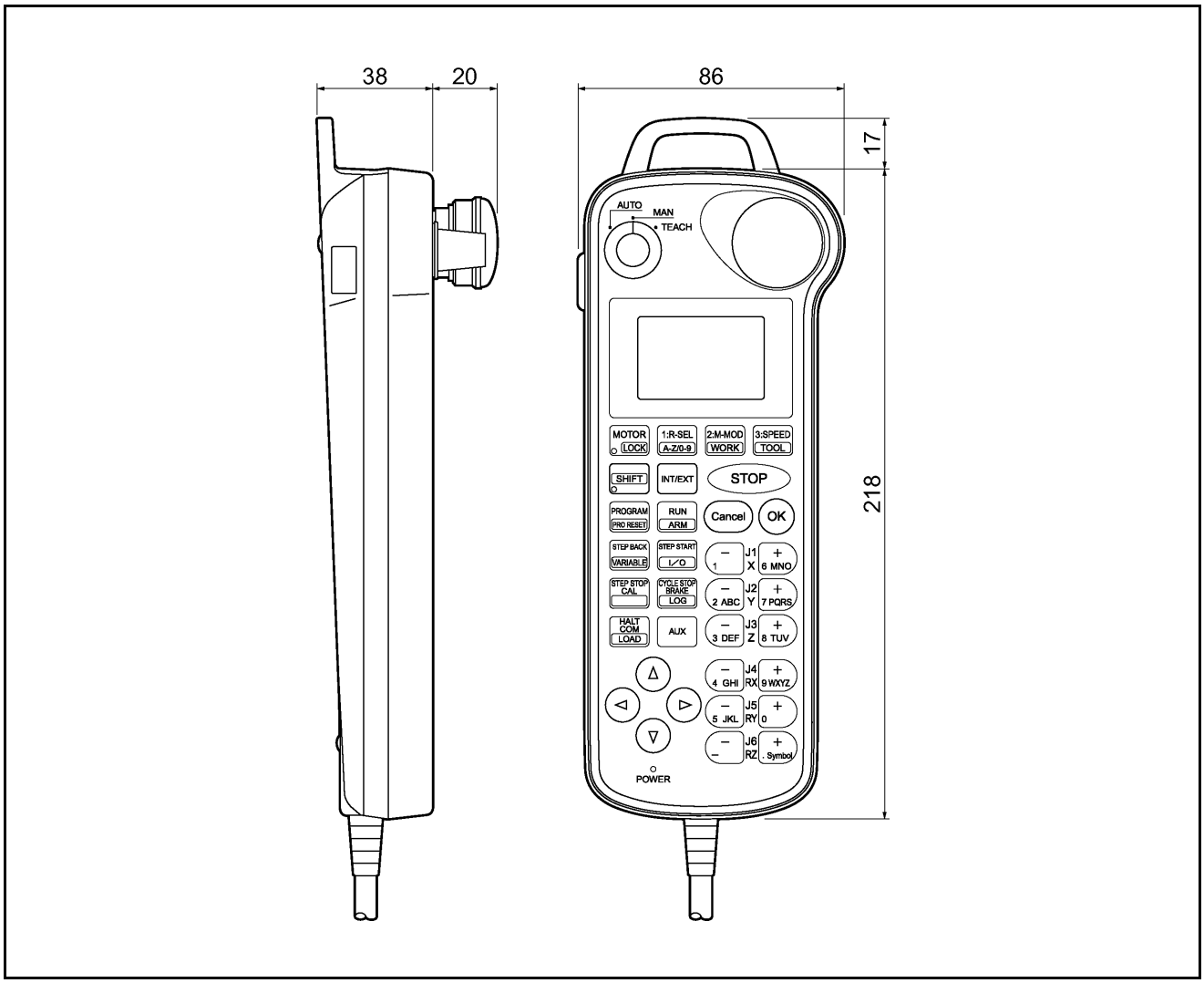
The table below lists the mini-pendant specifications.

Mini-Pendant Specifications

Item	Specifications
Model	MP5J4K (with 4 m cable) MP5J8K (with 8 m cable) MP5J12K (with 12 m cable)
Display	Liquid crystal display, 128 × 64 pixels
Power source	24 VDC (supplied from robot controller)
Operation	33 membrane switches, robot stop button, mode selector switch, deadman switch
Installation conditions	Temperature: 0 to 40°C Humidity: 90% RH or less (Dew condensation shall not be allowed.)
Outside dimensions (W) x (H) x (D)	86 x 218 × 38 mm (excluding projections such as switches)
Weight	Approx. 0.3 kg (excluding cables. See **Note** below.)
Cable length	4 m, 8 m, or 12 m
Accessory	WINCAPSII Light
Note: Cable weight Approx. 0.2 kg (4 m), 0.4 kg (8 m), 0.6 kg (12 m)	

3.3.2 Outer Dimensions

The figure below shows the outer dimensions of the mini-pendant.



Outer Dimensions of the Mini-Pendant

3.3.3 Connecting the Mini-Pendant

You may connect the mini-pendant to the "pendant" connector on the robot controller. When it is connected, neither the teach pendant nor operating panel can be used concurrently.

3.4 Specifications of WINCAPSII Light

WINCAPSII Light that comes with the mini-pendant is PC teaching system software. It is a functionally limited version of WINCAPSII.

Except that WINCAPSII Light is limited to the following functions, it is the same as WINCAPSII. Refer to WINCAPSII given in the next chapter.

Entering and editing robot programs

In WINCAPSII Light, you may enter or edit robot programs. You may also develop new programs by making use of existing programs.

Reading/writing programs and data

WINCAPSII Light may read programs, variables, coordinate values, CALSET data, log data, and other data from the robot controller and display them on the PC screen or can write them to the robot controller.

NOTE: To use this function, the robot controller and the PC must be connected with each other using a communications cable.

Saving programs and data

WINCAPSII Light may store programs, CALSET data, log data, and other data onto the hard disk or floppy disks. It may also read out those stored data and re-edit or write them to the robot controller.

Getting a snapshot

WINCAPSII Light may get a snapshot containing robot motion data from the robot controller and display the robot motion at one particular point in time on the PC screen, enabling you to check it.

Chapter4
PC Teaching System Software, "WINCAPSII"

The PC teaching system facilitates the creation and editing of robot programs. Use this system to improve creation and/or robot management programs. For further information about how to use this teaching system, refer to the WINCAPSII GUIDE.

4.1 Functions in WINCAPSII

WINCAPSII has the following functions:

Entering and editing robot programs

In WINCAPSII, you may enter or edit robot programs. You may also develop new programs by making use of programs supplied as a library or with existing programs.

Reading/writing programs and data

WINCAPSII may read programs, variables, coordinate values, CALSET data, log data, and other data from the robot controller and display them on the PC screen or can write them to the robot controller.

NOTE: To use this function, the robot controller and the PC must be connected with each other using a communications cable.

Saving programs and data

WINCAPSII may store programs, CALSET data, log data, and other data onto the hard disk or floppy disks. It may also read out those stored data and re-edit or write them to the robot controller.

Printing programs and data

If you connect a printer to the PC, WINCAPSII may print out programs, CALSET data, log data, and other data.

Simulating the robot motion

WINCAPSII may simulate the robot motion in animation on the PC screen.

NOTE: To use this function, the robot controller and the PC must be connected with each other using an interface cable.

During automatic operation or manual operation using the teach pendant, the simulated image moves corresponding to the actual robot motion.

4.2 Operating Environment Required

The PC teaching system software requires the operating environment listed below.

Operating Environment for the PC Teaching System Software

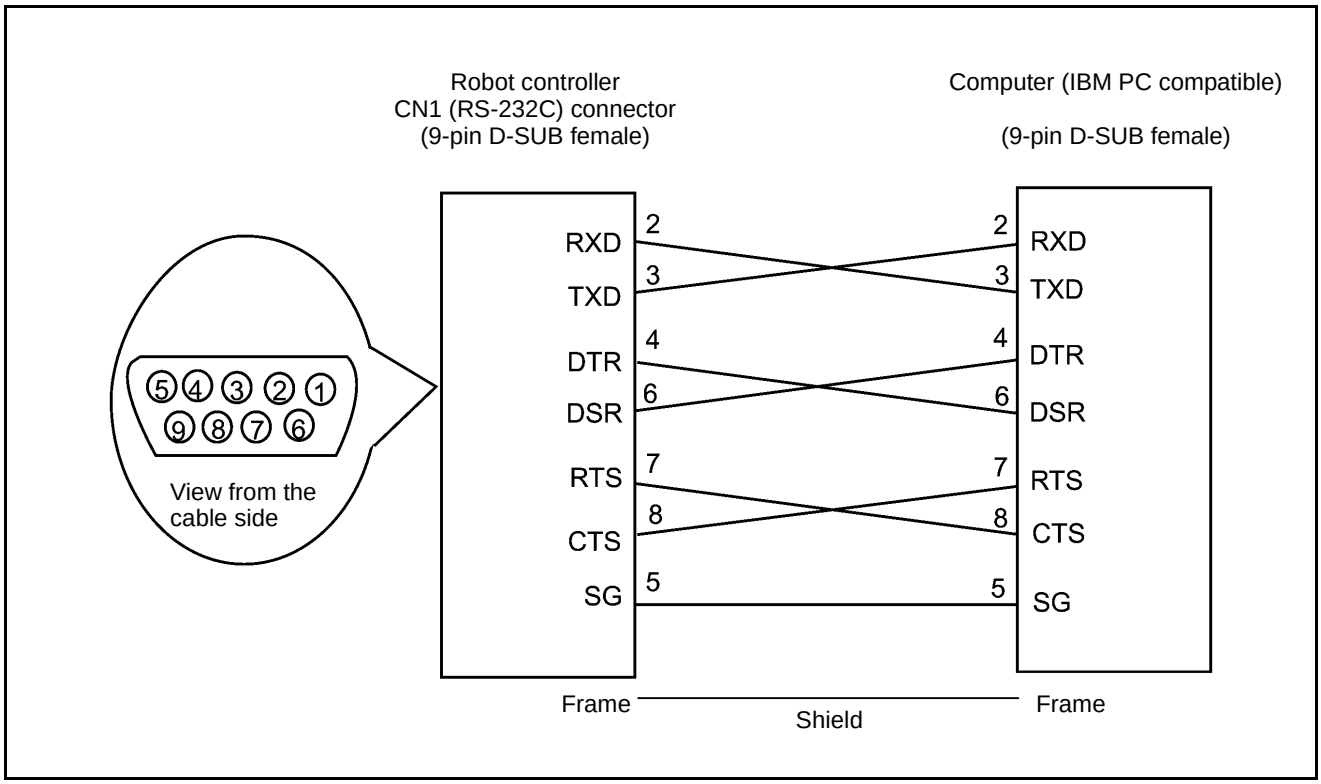
CPU	Pentium or higher capacity
OS	Windows 95 or upper version (See Note 1.)
Memory	32 MB or more (64 MB recommended)
Hard disk	A free area of 80 MB or more is required at installation.
Monitor resolution	640 × 480 or higher

Note 1 WINCAPSII cannot run properly on earlier versions of Windows 95.

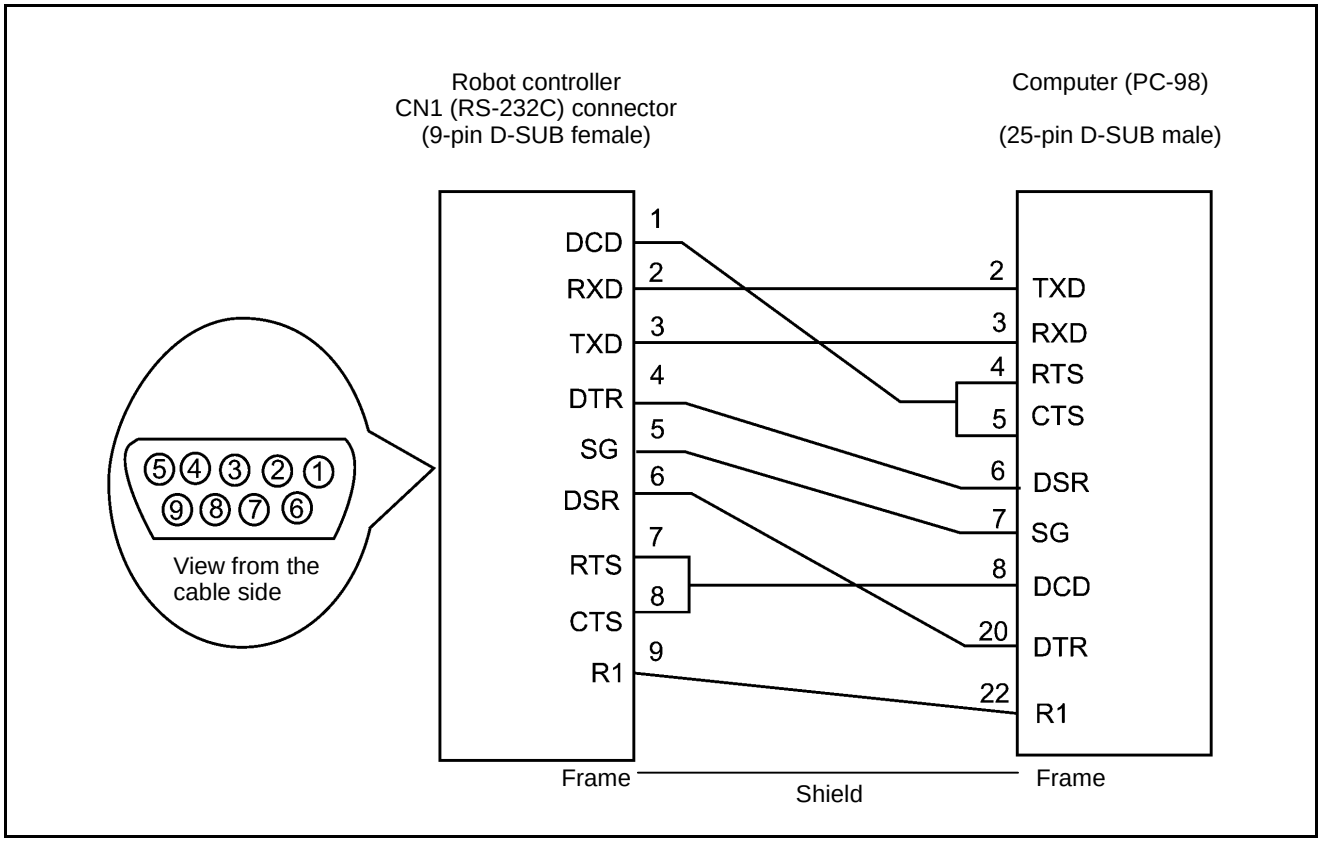
The version of Windows 95 can be checked with [Control Panel – System – Information]. If A, B or C is not displayed (no symbol) at the end of the version information (4.00, 95B), update your Windows 95 with the Windows 95 Service Pack 1 that is available from the Microsoft's web site.

4.3 Communications Cable

To enable the computer and the robot controller to communicate with each other, they must be connected with a communications cable. Use the appropriate RS-232C for cross cable wiring, as shown below.



RS-232C Communication Cable Wiring Diagram (IBM PC compatible)



RS-232C Communications Cable Wiring Diagram (PC-98)

PART 2 OPTIONAL BOARDS FOR RC5 CONTROLLER

Chapter5 Floppy Disk Drive

The floppy disk drive is an optional storage device that stores or reads data such as robot programs, to/from a floppy disk. It may be built in the robot controller.

5.1 Floppy Disk Drive Functions

The floppy disk drive has the following functions:

Formatting

This function initializes a floppy disk so that it can store data. You need to initialize a new floppy disk before use.

Floppy disks will be initialized in MS-DOS format.

Saving

This function stores programs, CALSET data, etc. from the robot controller onto a floppy disk.

Loading

This function reads programs, CALSET data, etc. from a floppy disk to the robot controller.

> ⚠**Caution** **NEVER load the CALSET data prepared for other robots. If loaded, the robot will malfunction. It is DANGEROUS.**

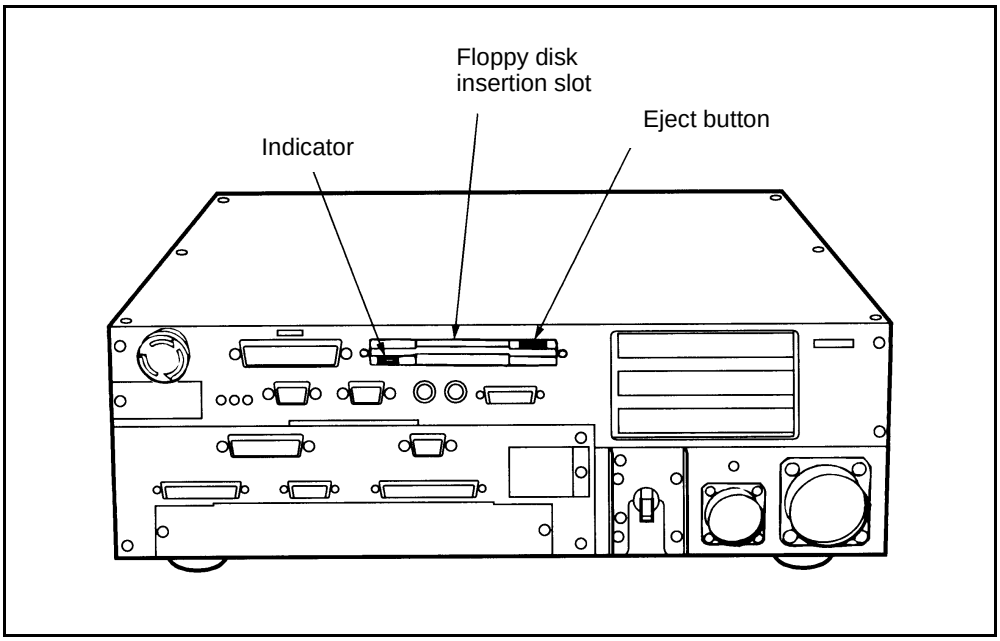
5.2 Floppy Disk Drive Specifications

The table below lists the specifications of the built-in floppy disk drive.

Table 3-6 Built-in Floppy Disk Drive Specifications

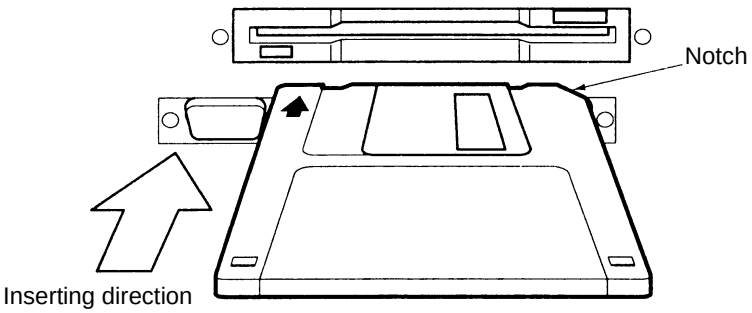
Item	Specifications	
Power source	5 VDC (supplied from the robot controller)	
Environmental conditions	Temperature : 5 to 40°C Humidity : 20% to 80% (without dew condensation)	
Weight	155 g (body alone)	
Applicable floppy disk	Type	2HD, 3.5-inch floppy disk
	Storage capacity	1.44 MB

5.3 Location of the Floppy Disk Drive and its Component Names



Location of the Floppy Disk Drive and its Component Names

Floppy disk insertion slot	Insert a floppy disk through this slot. (See the figure given below.)
Eject button	Push this button to eject the floppy disk.
Indicator	This lamp comes ON when the floppy disk is accessed.



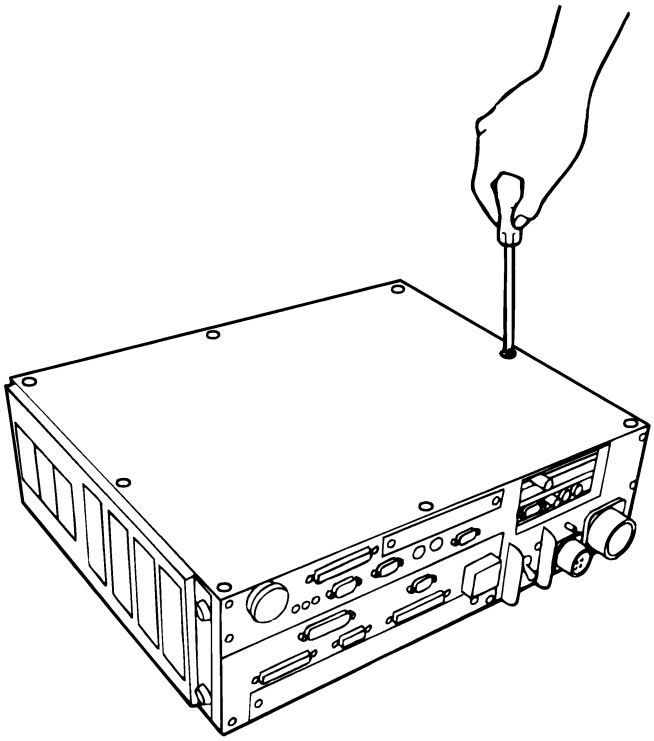
Inserting a Floppy Disk

Caution: Do not eject the floppy disk when the indicator is lit. Doing so will damage or destroy data stored on the floppy disk.

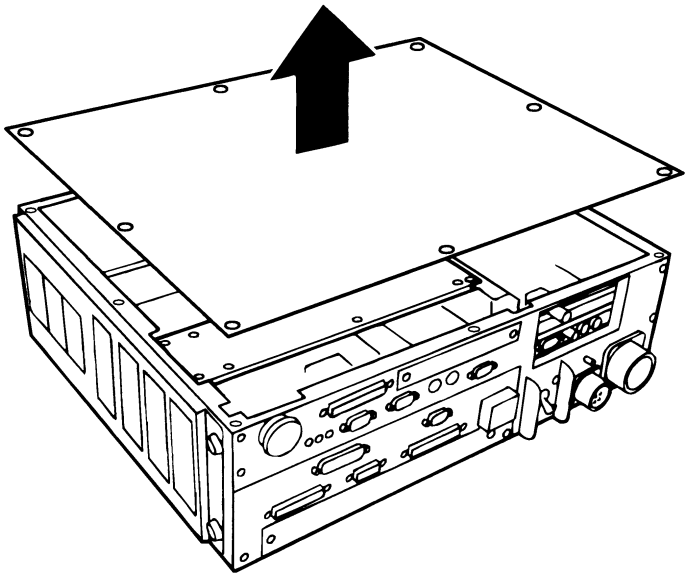
5.4 Mounting the Floppy Disk Drive

Mount the floppy disk drive into the robot controller according to the following procedure:

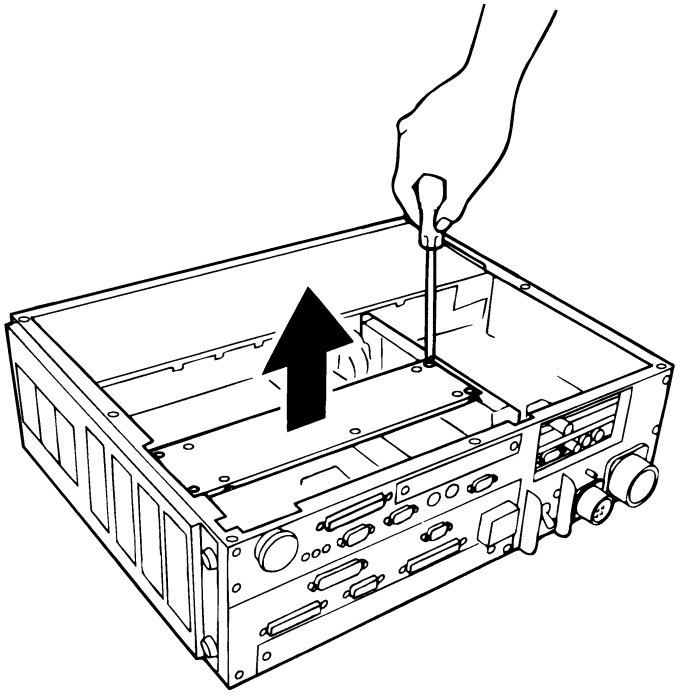
Step 1 Remove the eight screws from the controller top cover.



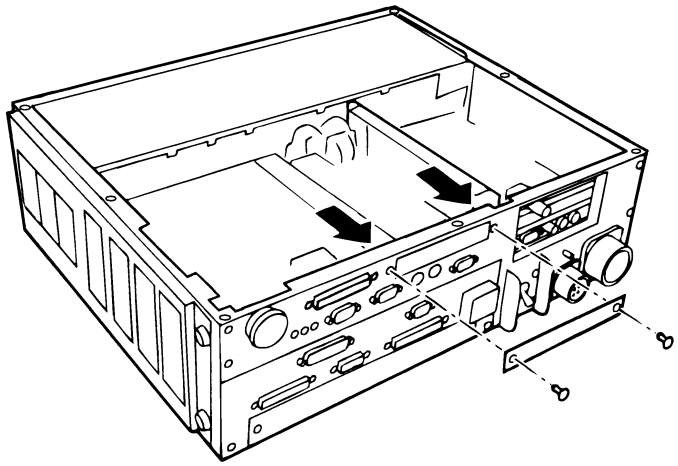
Step 2 Lift the top cover up and off the robot controller.



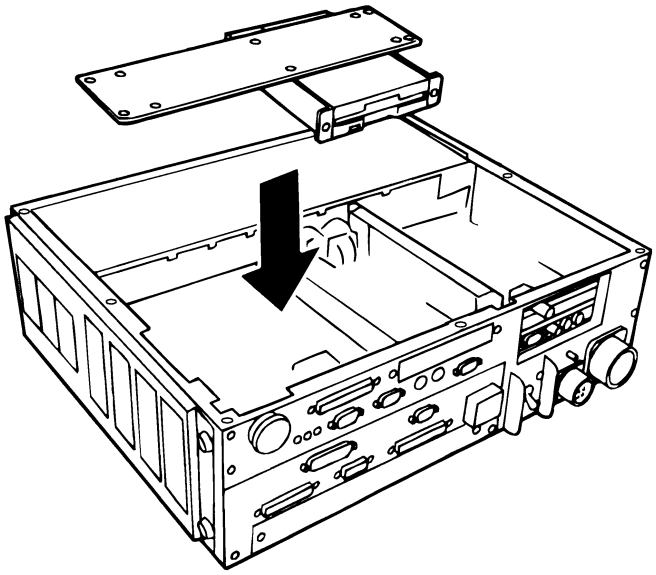
Step 3 Remove the four screws from the upper plate and take off the upper plate.



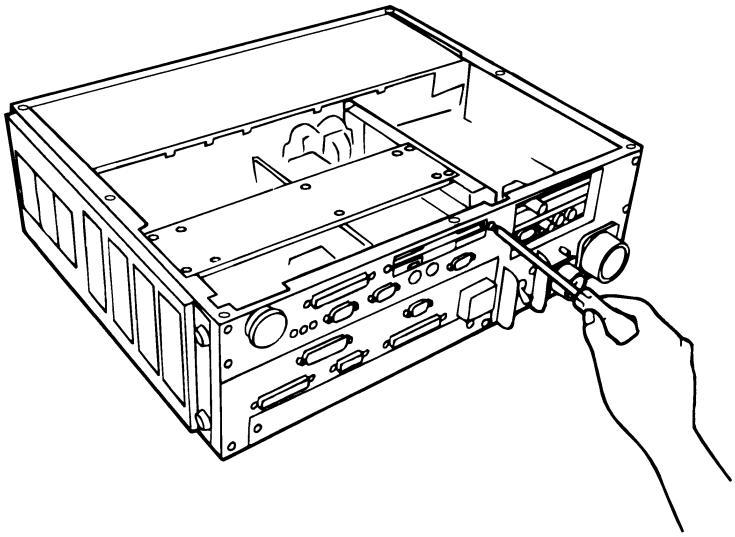
Step 4 Push the two pins of the blank cap outwards and remove the blank cap.



Step 5 Mount the floppy disk drive in the appropriate position of the robot controller. The floppy disk drive is secured to a disk drive mounting plate.

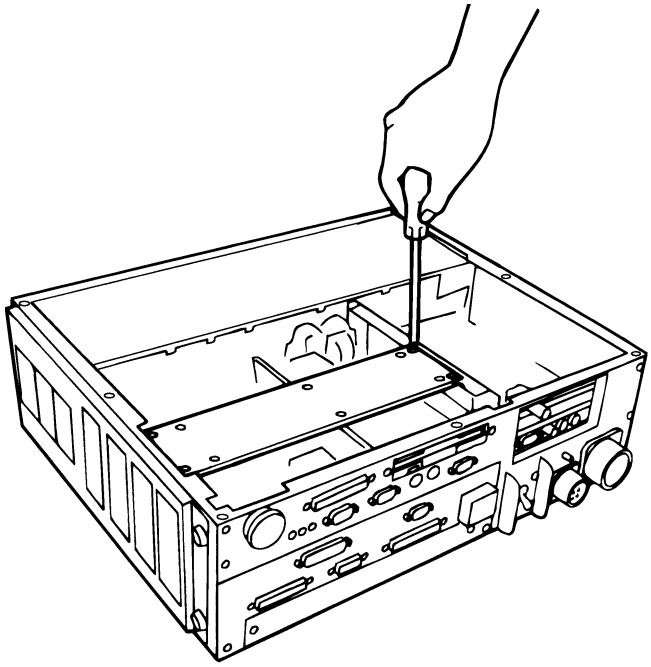


Step 6 Secure the front panel of the floppy disk drive with two screws.



Step 7

Secure the floppy disk drive mounting plate with four screws.

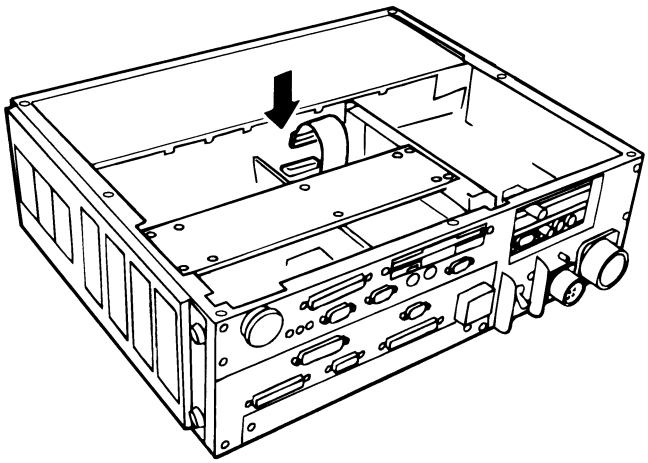


Step 8

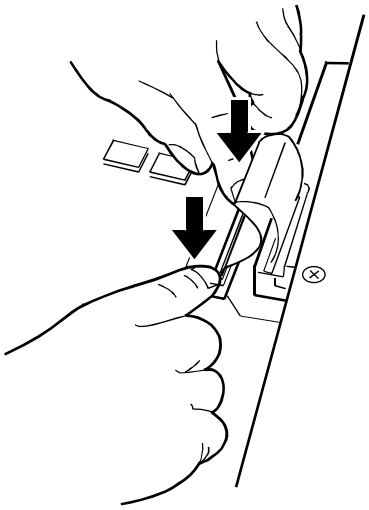
Connector J6 FDD 26P on the printed circuit board has a cable lock.

If the connector is locked, lift and unlock it. The lock is made of resin. Do not apply excessive force to it since the lock could easily break. Handle it with extra care.

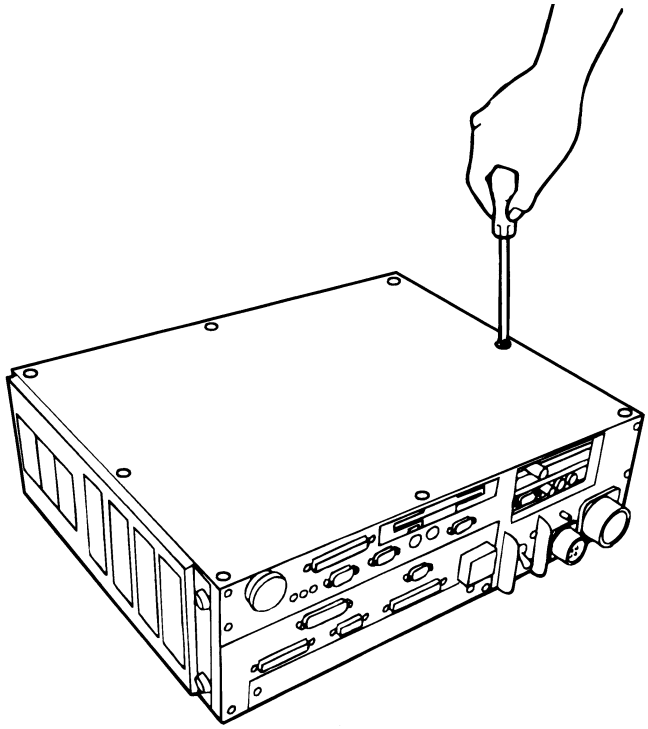
Fully insert the flat cable of the floppy disk drive into connector J6 FDD 26P on the circuit board. If the flat cable is inserted fully, the blue line marked on the connecting section will become aligned with the top edge of the connector.



Step 9 Securely push in the connector lock.



Step 10 Put the top cover and secure it with eight screws.



The mounting of the floppy disk drive is completed.

Chapter6 μVision Board

6.1 μVision Board Specifications

If the robot controller has a built-in μVision board, it can handle a variety of image processor functions.

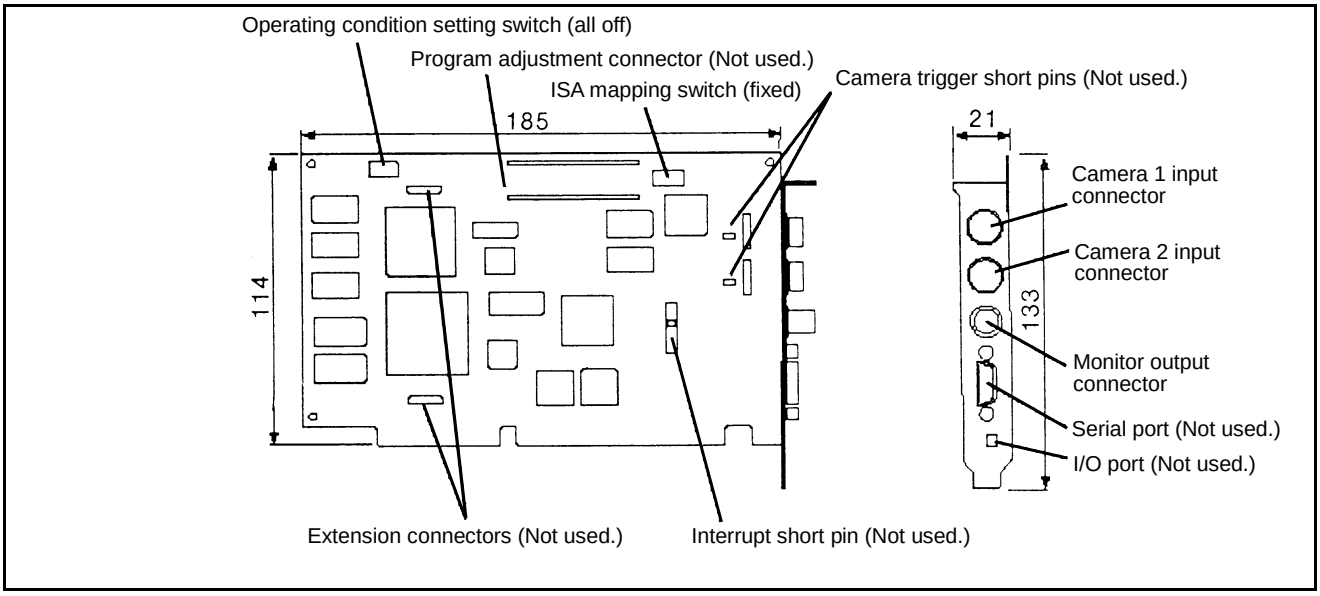
Similar to other commands, image processing commands are already incorporated and no special operations or programming are required.

μVision Board Specifications

Item	Specifications
CPU	32-bit CPU
Image storage memory for processed images (Horizontal x Vertical)	512 × 480 pixels, 8 bits × 4 screens
Overlay memory for drawn images (Horizontal x Vertical)	624 × 480 pixels, 2 bits × 2 screens
Search model registration memory	1 MB (H255 × V255 × 8 models), Up to 100 models registrable **Note (1)**
Image input, number of channels	EIA/CCIR monochrome, 256 gradations, 2 channels
Image output	EIA/CCIR monochrome, 256 gradations, 1 channel
Image processing	Binary feature extract (area, center of gravity, main axis angle, luminance integration), histogram, edge detection, image-to-image operation, filtering, labeling, light/dark image search, code recognition (QR code)
Processing range specification (window)	Up to 512 windows registrable (shape: straight line, rectangle, circle, ellipse, sector)
Self-diagnosis function	Memory check, incorrect input, incorrect processing range, improper camera connection, etc.
Error display	Errors will be displayed on the teach pendant (option).
Power source	5 VDC, 12 V (supplied from controller ISA) **Note (2)**
Environmental conditions (during operation)	Temperature: 0 to 40°C Humidity: 90 %RH or less (Dew condensation shall not be allowed.)
Outside dimensions (H x W x D)	21.4 × 114 × 185 mm (excluding projections of connectors)

Note (1) The number of registrable models will differ depending upon the model image and/or size.

(2) Since power is supplied from the inside of the robot controller, no external power source is required.



µVision Board

Note (1) Switches and the short pins on the µVision board have been set at the factory. Do not change the settings. A failure may result.

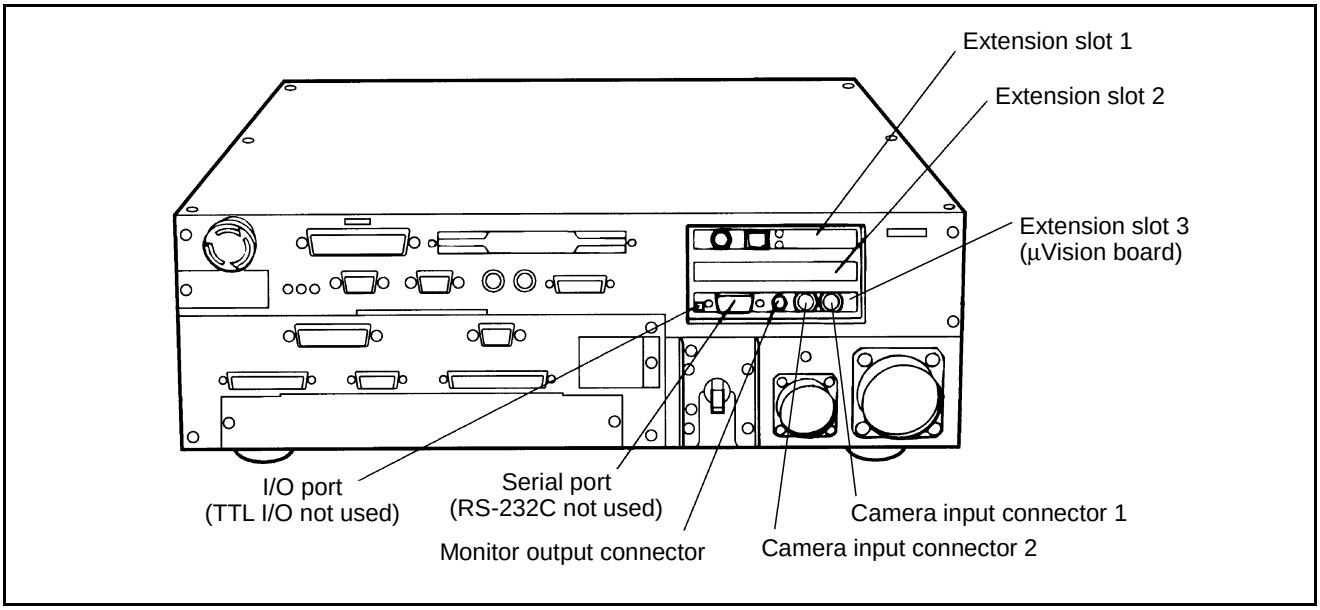
Note (2) Do not connect anything to the unused connectors on the board. A failure may result.

Note (3) The serial port and the I/O port on the board are unusable. Do not connect anything to them. A failure may result.

6.1.1 Location of the μVision Board and Names of Connectors

Insert a μVision board into extension slot 3 shown in the figure below.

Inserting the board in a wrong slot may damage the internal circuits of the robot controller. For the installation procedure, refer to Chapter 11, "Mounting Extension Boards."



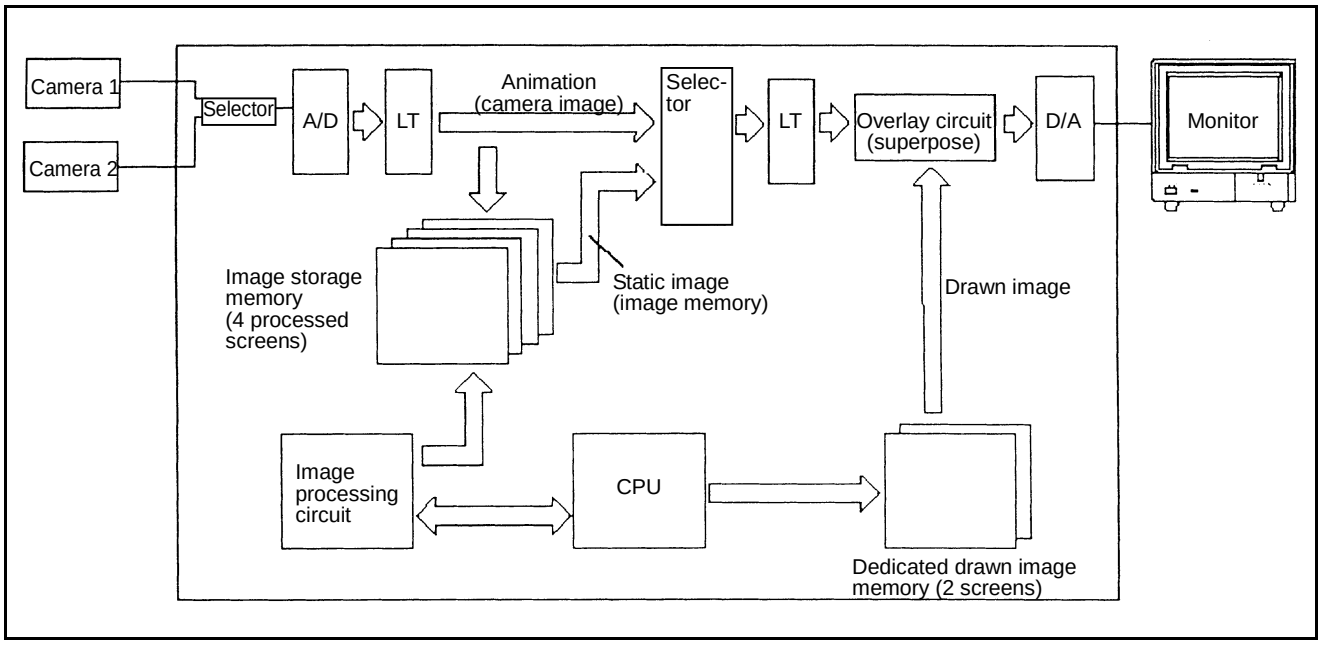
Location of μVision Board and Names of Connectors

Camera input connector 1	Used for connection with camera 1 (12-pin, round connector)
Camera input connector 2	Used for connection with camera 2 (12-pin, round connector)
Monitor output connector	Used for connection with the monitor (BNC).
Serial port	RS-232C port (Not used.)
I/O port	TTL level input/output: 1 point each (Not used.)

Camera Input Connector Pin Layout
(Manufacturer: Hirose Electric HR10A-10R-12S or equivalent)

Pin No.	Signal name	Remarks
1	GND	Camera power GND
2	+12V	Camera power 12V
3	GND	Camera power GND
4	VIDEO	Video signal
5	HDGND	HD synchronous signal GND
6	HD	Horizontal synchronous signal
7	VD	Vertical synchronous signal
8	NC	Not connected
9	NC	Not connected
10	NC	Not connected
11	TRIG	Trigger signal (not used)
12	VDGND	VD synchronous signal GND

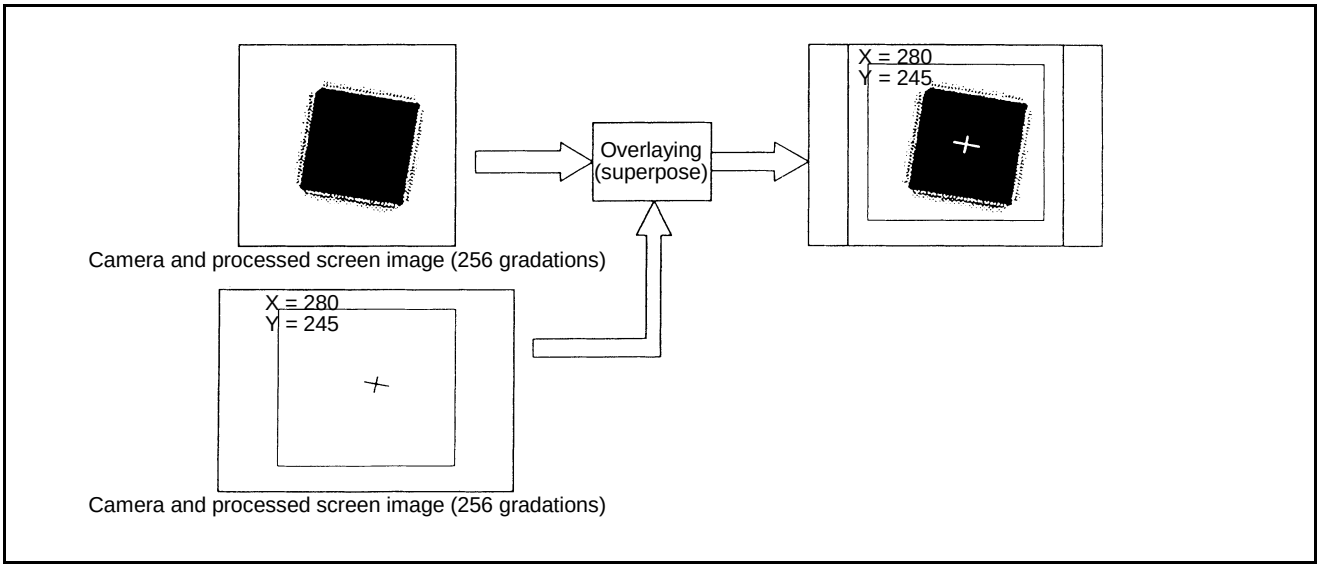
6.1.2 Block Diagram and Internal Configuration of μVision Board



Block Diagram of μVision Board

The above figure illustrates the processing flow of the μVision board as a reference. The actual circuit configuration is different from this diagram.

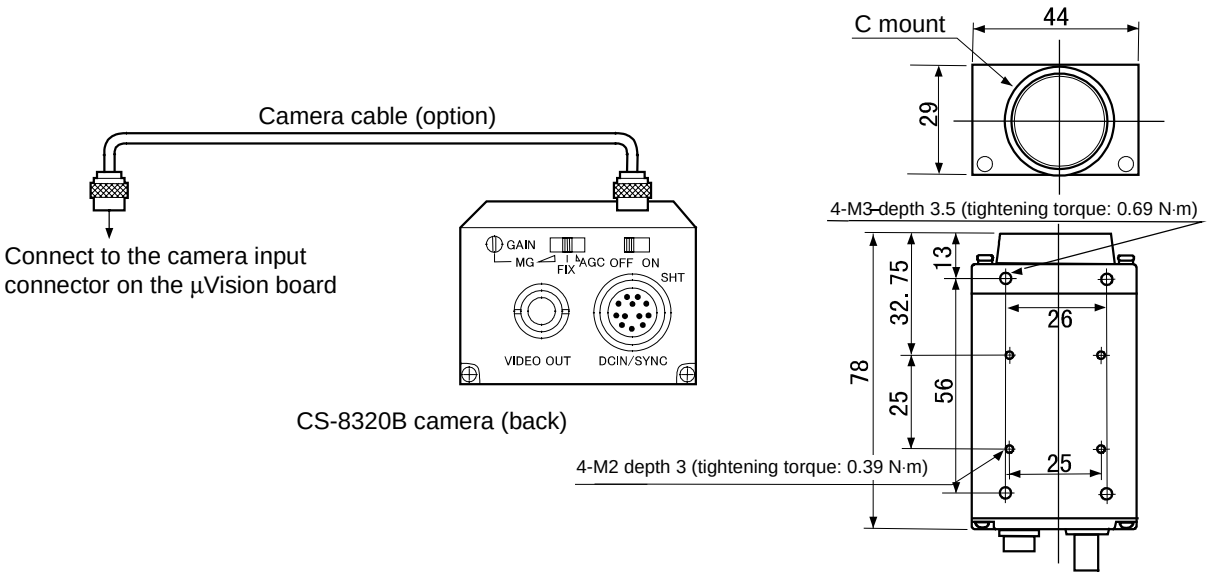
Camera selector	Switches between camera 1 and 2.
A/D	Converts analog signals into digital signals (8-bit).
Monitor selector	Selects whether to display the camera live image or static image on the monitor.
LT	Converts 8-bit data values using the appropriate table.
Overlay circuit	Overlays a drawn image, which is stored in the dedicated drawn image memory, on the camera live image or static image (see the figure given on the next page).
D/A	Converts digital data into analog signals.
Image storage memory	Stores camera live images. When outputted onto the monitor screen, those images will be handled as static images. Up to four screens can be stored on this board.
Dedicated drawn image memory	Stores drawn images of characters and figures. Those images can be displayed on the monitor screen via the overlay circuit. Up to two screens can be stored on this board.
Image processing circuit	Processes images.
CPU	Manages the entire system.



Overlay Concept

6.2 Peripheral Devices

6.2.1 General Information about the Camera



Camera Dimensions and its Parts Names

Camera Specifications

Item	Specifications
Manufacturer	Tokyo Electronic Industry Co., Ltd.
Manufacturer's model	CS8320B
Image pickup interline transfer system	CCD pixels: 768 (H) × 493 (V)
Lens mount	C mount
Image output NTSC signal	1.0 Vp-p/75 Ω
Power source/Ambient temperature	Supplied from power adapter, 0 to +40°C
Weight	120 g
Vibration-proof	98 m/s, 10G (10 to 50 Hz, 30 minutes in each of X, Y and Z directions)

Cables (Option)

Cable length	Camera cable model
3 m	CPC3440-03
5 m	CPC3440-05
15 m	CPC3440-15

Caution

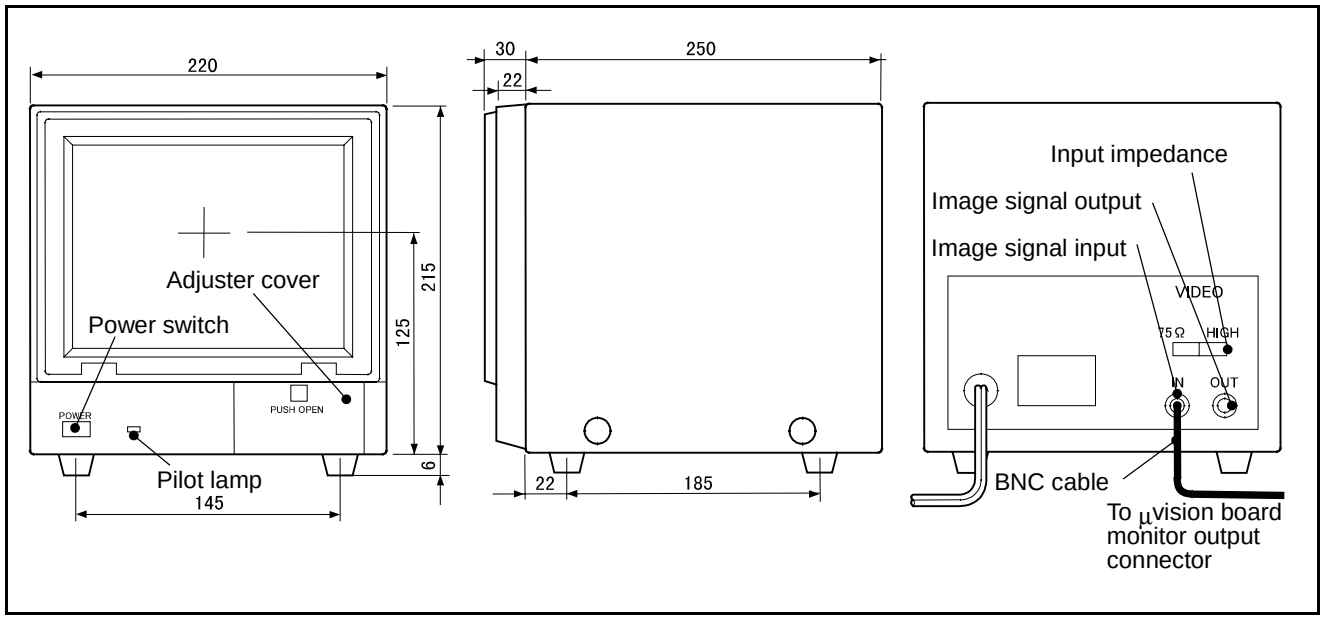
(1) When mounting the camera to the equipment, tighten the screws securely to the specified torque. See the figure given on the previous page.

(2) Do not apply a strong impact or vibration to the camera. A failure may result.

(3) When opening the camera top cover and changing the settings, be sure to turn the controller power off or disconnect the camera cable.

(4) For setting up cameras, refer to the instruction manual that comes with the camera.

6.2.2 General Information about the Monitor



Monitor Dimensions and its Parts Names

Monitor Specifications

Item	Specifications
Manufacturer	Chuo Musen Co., Ltd.
Manufacturer's model	TMP-233-03
Cathode-ray tube	9-inch, monochrome
Image input NTSC signal	0.7 Vp-p (straight polarity)
Power supply	100 VAC, 50/60 Hz
Power consumption	Approx. 30 W
Ambient temperature	0 to 40°C
Humidity	90% or less (without dew condensation)

Cables (Option)

Cable length	BNC coaxial cable type
1 m	3CV-PP (1)
3 m	3CV-PP (3)
5 m	3CV-PP (5)

Caution (1) NEVER disassemble the monitor.
(2) Be sure to set a ferrite core clamp (ZCAT1518) that comes with the BNC cable, to the monitor output connector side on the μVision board.

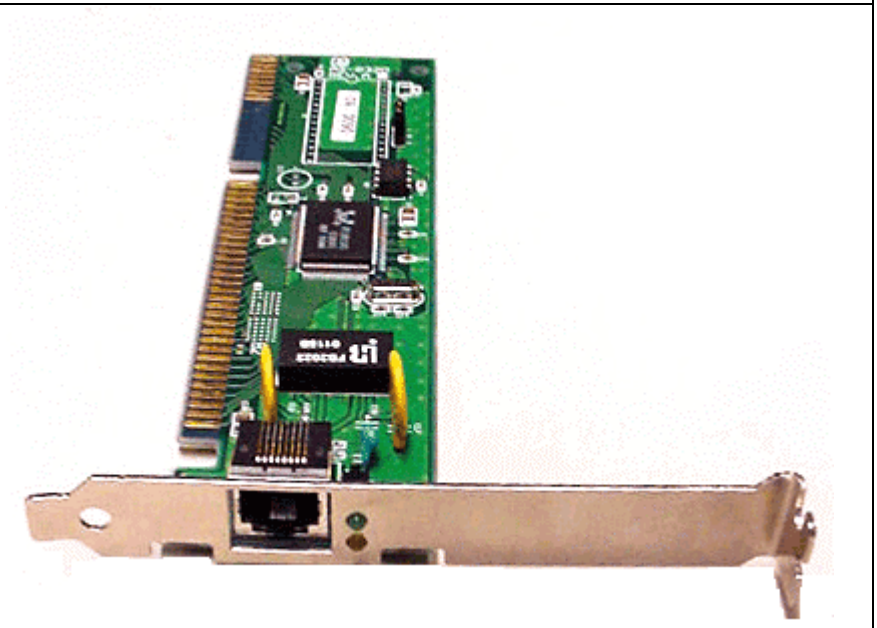
Chapter7 Ethernet Board

If the robot controller has a built-in Ethernet board, it can communicate with the PC teaching system according to the TCP/IP protocol.

This board is helpful for communication between a single PC teaching system and more than one robot controller. It also provides faster communication than an RS-232C cable, contributing to improved response of the PC teaching system.

7.1 Components in Package

Check that following components are contained in the package of the Ethernet board.

Components	Appearance
Ethernet board	
Ferrite clamp sleeve (RFC-10 KITAGAWA INDUSTRIES CO. , LTD.)	

7.2 Ethernet board specifications

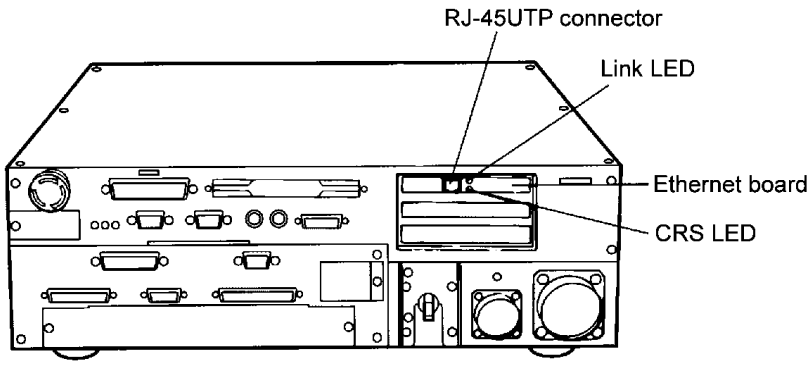
The specifications of the Ethernet board are shown in the figure below.

Ethernet Board Specifications

Item	Specifications
Connection	10BaseT (IEEE 802.3)
Baud rate	10 Mbits/sec.

7.3 Ethernet Board Parts Names

The parts names of the Ethernet board and its functions are shown in the figure and the table below.



Ethernet Board Parts Names

LEDs and Connector on the Ethernet Board

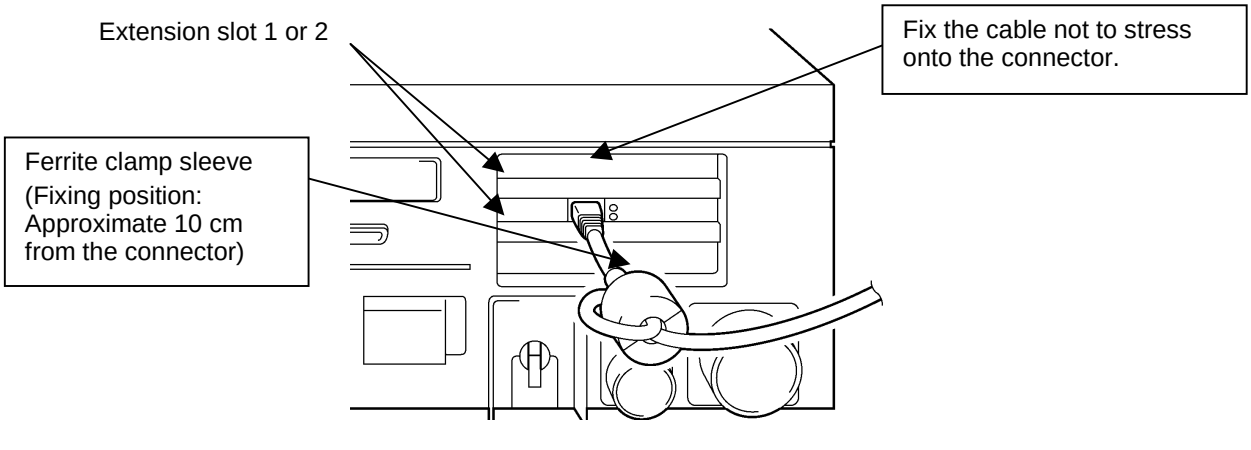
Name	Function
Link LED	Lights if the UTP port detects a signal.
CRS LED	Lights if a carrier signal is detected. This LED will remain ON if no cable is connected to the UTP connector.
RJ-45 UTP connector	Used for 10BaseT connection.

7.4 Mounting the Ethernet Board

(1) Insert the Ethernet board in extension slot 1 (upper slot) or extension slot 2 (middle slot) on the controller. For installation procedure of the Ethernet board, refer to Chapter 11, "Mounting Extension Boards."

(2) Attach the ferrite clamp sleeve onto the cable and connect the cable to the controller as shown in the figure below.

Caution: Fix the cable not to stress onto the connector. The stress onto the connector may occur communication error.


Extension slot 1 or 2
Fix the cable not to stress onto the connector.
Ferrite clamp sleeve
(Fixing position:
Approximate 10 cm
from the connector)

Chapter8 DeviceNet Slave Board

8.1 Overview

If the robot controller has a built-in DeviceNet slave board, it can communicate with external devices according to the DeviceNet-compliant protocol.

As a slave unit for serial communications which is compliant with the open network DeviceNet, the robot controller may easily exchange I/O data with a variety of DeviceNet-compliant control devices of many manufacturers.

8.1.1 Features

(1) DeviceNet-compliant

The DeviceNet is an internationally open network developed by Allen-Bradley and is designed to allow control devices (e.g., sensors and actuators) to communicate with each other.

(2) Can be networked with control devices of various manufacturers

The robot controller equipped with DeviceNet slave board can be networked with DeviceNet-compliant control devices of various domestic and foreign manufacturers since the communications specifications are open.

(3) Easy wiring and maintenance

The 5-core special cable and detachable connector of the DeviceNet slave board make it easy to install wiring between nodes (communications units) and disassembly/restructure the network. This will sharply reduce cost in wiring and maintenance, as well as making replacement of units easy at the time of failure.

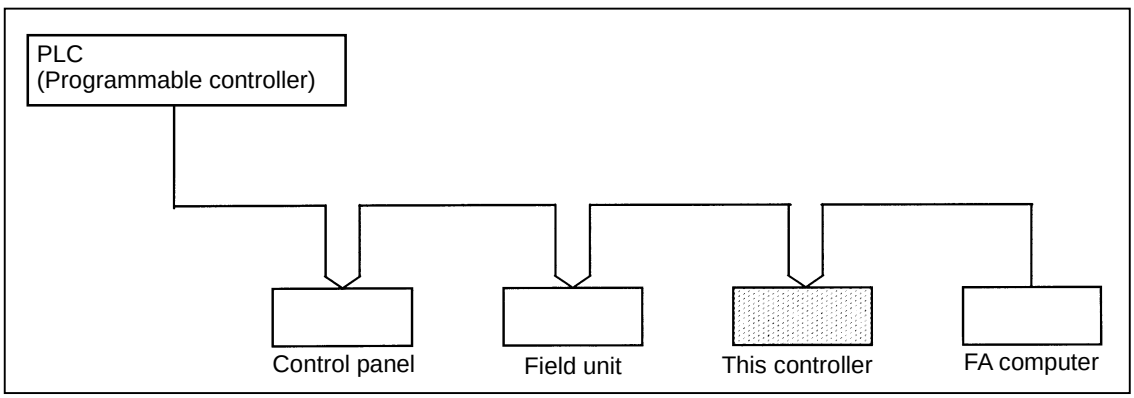
(4) Sufficient number of I/Os

The controller is capable of handling a large quantity of I/O data as listed below. Further, increase or decrease of the number of user-input I/Os is possible in units of 8 steps.

	Number of I/Os	
Transmission	Standard assignment mode	24 to 224
	Compatible assignment mode	24 to 224
Reception	Standard assignment mode	24 to 216
	Compatible assignment mode	40 to 232

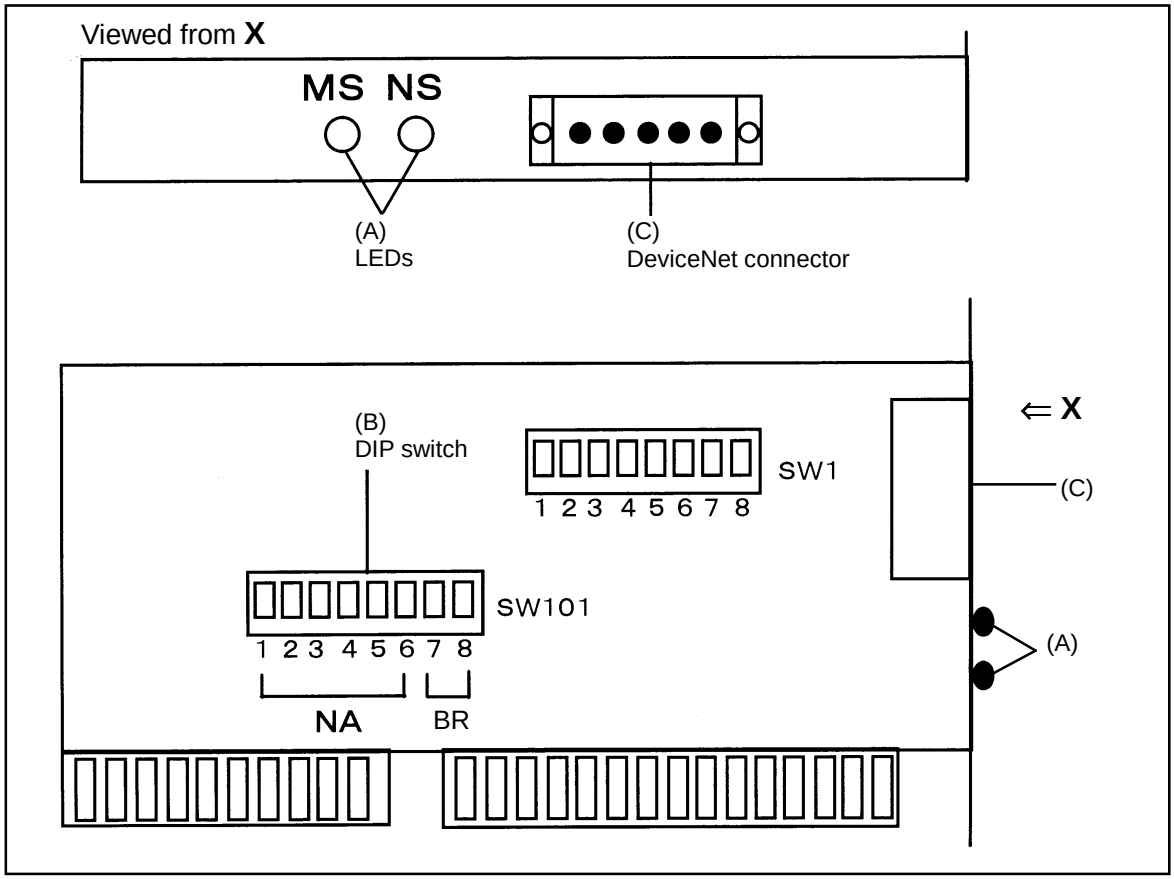
8.1.2 Typical Network

The figure below illustrates a typical network.



8.2 Product Specifications

The figure below shows the location of the LEDs, DIP switches, and DeviceNet connector on the DeviceNet slave board.



8.2.1 Names and Functions of Slave Board Components

(A) Status indicator LEDs

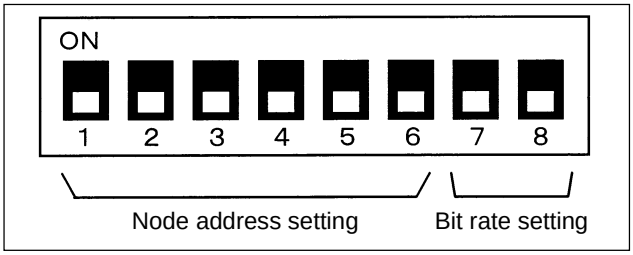
The status indicators MS and NS ("A" in the figure given on the previous page) can light or flash in green or red. Each of the ON, flashing, and OFF states of those indicators shows the module or network status as listed below.

The flashing interval is once per second (0.5 second of ON and 0.5 second of OFF).

LED name	Color	State	Definition	Explanation
MS (Module Status)	Green		Normal state	• The unit works normally.
			Setup not completed	• Reading the DIP switch settings.
	Red		Fatal error	• Hardware failure.
			Recoverable error	• Wrong DIP switch settings, etc.
	–		No power supplied	• No power is supplied to the DeviceNet module. • Resetting data. • Waiting for initialization.
NS (Network Status)	Green		Communications link established	The network is working normally. (The line is connected.)
			Communications link not established	The network is working normally, but the line is not connected yet.
	Red		Fatal communications error	The unit detects any error disabling communication on the network. • Node address double-assigned. • "Bus off" detected.
			Recoverable communications error	Communications error in some slaves.
	–		Network power supply failure	• Not connected to the master unit. • Communications line broken.
: ON : Flashing : OFF				

(B) DIP switch (SW101)

Use the DIP switch for setting the node address and bit rate as shown below.



DIP Switch Setting

NOTE: Always turn off the controller power (including the network power) before setting the DIP switch.

Setting the node address

Set the node address of the robot controller using selectors 1 through 6 of the DIP switch, referring to the table below. You may freely set any of 0 through 63 to a node address unless the address is double-assigned on the same network including the master and slaves. Double assignment will cause an address double-assignment error, disabling the network.

Node Address Setting by the DIP Switch

DIP switch						Node address	DIP switch						Node address
1 (32)	2 (16)	3 (8)	4 (4)	5 (2)	6 (1)		1 (32)	2 (16)	3 (8)	4 (4)	5 (2)	6 (1)	
0	0	0	0	0	0	0	0	0	0	0	0	0	32
0	0	0	0	0	1	1	0	0	0	0	0	1	33
0	0	0	0	1	0	2	0	0	0	0	1	0	34
0	0	0	0	1	1	3	0	0	0	0	1	1	35
0	0	0	1	0	0	4	0	0	0	1	0	0	36
0	0	0	1	0	1	5	0	0	0	1	0	1	37
0	0	0	1	1	0	6	0	0	0	1	1	0	38
0	0	0	1	1	1	7	0	0	0	1	1	1	39
0	0	1	0	0	0	8	0	0	1	0	0	0	40
0	0	1	0	0	1	9	0	0	1	0	0	1	41
0	0	1	0	1	0	10	0	0	1	0	1	0	42
0	0	1	0	1	1	11	0	0	1	0	1	1	43
0	0	1	1	0	0	12	0	0	1	1	0	0	44
0	0	1	1	0	1	13	0	0	1	1	0	1	45
0	0	1	1	1	0	14	0	0	1	1	1	0	46
0	0	1	1	1	1	15	0	0	1	1	1	1	47
0	1	0	0	0	0	16	0	1	0	0	0	0	48
0	1	0	0	0	1	17	0	1	0	0	0	1	49
0	1	0	0	1	0	18	0	1	0	0	1	0	50
0	1	0	0	1	1	19	0	1	0	0	1	1	51
0	1	0	1	0	0	20	0	1	0	1	0	0	52
0	1	0	1	0	1	21	0	1	0	1	0	1	53
0	1	0	1	1	0	22	0	1	0	1	1	0	54
0	1	0	1	1	1	23	0	1	0	1	1	1	55
0	1	1	0	0	0	24	0	1	1	0	0	0	56
0	1	1	0	0	1	25	0	1	1	0	0	1	57
0	1	1	0	1	0	26	0	1	1	0	1	0	58
0	1	1	0	1	1	27	0	1	1	0	1	1	59
0	1	1	1	0	0	28	0	1	1	1	0	0	60
0	1	1	1	0	1	29	0	1	1	1	0	1	61
0	1	1	1	1	0	30	0	1	1	1	1	0	62
0	1	1	1	1	1	31	0	1	1	1	1	1	63

Note 1 : Selector OFF and ON are expressed by 0 and 1, respectively. (Before shipment from the factory, the node address is set to 0 by default.)

Setting the bit rate

To match the bit rate of the robot controller with that of the network, use selectors 7 and 8 of the DIP switch, referring to the table below:

Bit Rate Setting By DIP Switch

Selectors on the DIP switch		Bit rate
Selector 7	Selector 8	
0	0	125 kbps
0	1	250 kbps
1	0	500 kbps
1	1	500 kbps

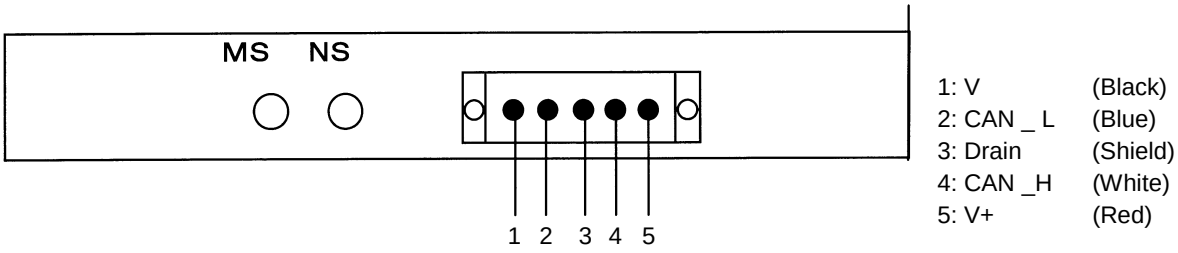
Note 1: Selector OFF and ON are expressed by 0 and 1, respectively. (Before shipment from the factory, both of these selectors are set to 0 (=500 kbps) by default.

Note 2: On the same network, set the same bit rate to all nodes (master and slaves). Otherwise, slaves whose bit rate is different from that of the master cannot communicate only, but also they may cause a communications error between correctly set nodes.

(C) DeviceNet connector

The robot controller uses an open screw connector whose pin arrangement is shown below.

NOTE: When the controller power (including the network power) is on, do not disconnect/connect the communication connector or touch its pins. Doing so will result in a failure.



It is recommended that either of the following crimp terminals be used for the communications cable.

No.	Crimp terminal	Tools required
(1)	AI series (Phoenix Contact)	ZA3 (Phoenix Contact)
(2)	TC series (Nichifu) For thin cables: TME TC-0.5 For thick cables: TME TC-2-11 (for power supply) TME TC-1.25-11 (for communication)	NH-32

8.2.2 General Specifications

The following tables list the controller environmental and communication specifications.

(1) Environmental requirements

Item	Specifications
Power requirements	5 VDC (supplied via the controller ISA bus)
Operating temperature	0 to 40°C
Operating humidity	90% RH or less (without condensation)

(2) DeviceNet communications specifications

<table>
<tr><td>Item</td><td colspan="4">Specifications</td></tr>
<tr><td>Communications protocol</td><td colspan="4">DeviceNet-compliant</td></tr>
<tr><td>Connection supported</td><td colspan="4">Master/slave connection : Polling I/O function
Compliant with DeviceNet communications rules</td></tr>
<tr><td>Connection type (Note 1)</td><td colspan="4">Multi-drop type with possible combination of T-branch
(to trunk and branch lines)</td></tr>
<tr><td>Bit rate</td><td colspan="4">500, 250, 125 kbps (selectable by switch)</td></tr>
<tr><td>Communications media</td><td colspan="4">Special cable consisting of 5 wires
(2 for signals, 2 for power supply and 1 as a shield wire)</td></tr>
<tr><td rowspan="4">Communications cable length</td><td>Bit rate</td><td>Max. network length</td><td>Branch length</td><td>Total branch length</td></tr>
<tr><td>500 kbps</td><td>100 m or less (Note 2)</td><td>6 m or less</td><td>39 m or less</td></tr>
<tr><td>250 kbps</td><td>250 m or less (Note 2)</td><td>6 m or less</td><td>78 m or less</td></tr>
<tr><td>125 kbps</td><td>500 m or less (Note 2)</td><td>6 m or less</td><td>156 m or less</td></tr>
<tr><td>Power supply for communication</td><td colspan="4">External supply of 24 VDC ±10%</td></tr>
<tr><td>Internal power consumption</td><td colspan="4">Communication power source: 30 mA max.</td></tr>
<tr><td>Max. number of connectable nodes</td><td colspan="4">64 nodes (including configurator (converter) if connected)</td></tr>
<tr><td>Number of I/Os</td><td colspan="4">Standard assignment mode:
40 points for system input
32 points for system output
24 points to 216 for user input
24 to 224 points for user output
The number of I/Os can be set in unit of 8 points.
Compatible assignment mode:
24 points for system input
32 points for system output
40 to 232 points for user input
24 to 224 points for user output
The number of I/Os can be set in unit of 8 points.</td></tr>
<tr><td>Error check</td><td colspan="4">CRC</td></tr>
<tr><td colspan="5">(Note 1) Terminator resistors are needed at both ends of the trunk line.
(Note 2) These values may apply when a special thick cable is used as a trunk line. If a special fine cable is used, the max. network length is 100 m or less.</td></tr>
</table>

8.3 Assignment of Serial I/O Data

Two types of serial I/O data assignment modes are available--standard assignment mode and compatible assignment mode (which is compatible with our previous models). In each of those assignment modes, serial input/output data are assigned as shown in [1] and [2].

The controller equipped with a DeviceNet slave board transfers the system input/output data only through the DeviceNet, disabling the parallel ports. The controller, however, can handle the user input/output data using both parallel ports and DeviceNet.

Signals such as *robot stop*, *enable auto*, and *CPU normal* are transferred only through the parallel ports.

8.3.1 Standard Assignment Mode

(1) Input Data

No.	Content	No.	Content	No.	Content	No.	Content
512	Step stop (all tasks)	520	Bit 0 in data area 1	528	Bit 0 in data area 2	536	Bit 8 in data area 2
513	–	521	Bit 1 in data area 1	529	Bit 1 in data area 2	537	Bit 9 in data area 2
514	Halt (all tasks)	522	Bit 2 in data area 1	530	Bit 2 in data area 2	538	Bit 10 in data area 2
515	Strobe signal	523	Bit 3 in data area 1	531	Bit 3 in data area 2	539	Bit 11 in data area 2
516	Skip interrupt	524	Bit 4 in data area 1	532	Bit 4 in data area 2	540	Bit 12 in data area 2
517	–	525	Bit 5 in data area 1	533	Bit 5 in data area 2	541	Bit 13 in data area 2
518	–	526	Bit 6 in data area 1	534	Bit 6 in data area 2	542	Bit 14 in data area 2
519	Command data odd parity	527	Bit 7 in data area 1	535	Bit 7 in data area 2	543	Bit 15 in data area 2

No.	Content	No.	Content			No.	Content
544	Bit 0 in command area	552	INPUT 552			760	INPUT 760
545	Bit 1 in command area	553	INPUT 553			761	INPUT 761
546	Bit 2 in command area	554	INPUT 554			762	INPUT 762
547	Bit 3 in command area	555	INPUT 555			763	INPUT 763
548	–	556	INPUT 556			764	INPUT 764
549	–	557	INPUT 557			765	INPUT 765
550	–	558	INPUT 558			766	INPUT 766
551	–	559	INPUT 559			767	INPUT 767

Note 1: Numerals in the No. column denote the I/O port numbers of the controller.
Note 2: The input data is handled in bytes (8 points). The default is 64 points. Up to 256 points can be used.

(2) Output Data

No.	Content	No.	Content	No.	Content	No.	Content
768		776	Robot warning	784	Bit 0 in status area	792	Bit 8 in status area
769	Robot running	777	Continue start permitted	785	Bit 1 in data area	793	Bit 9 in status area
770	Robot alarm	778	Reserved	786	Bit 2 in status area	794	Bit 10 in status area
771	Servo ON	779	Reserved	787	Bit 3 in status area	795	Bit 11 in status area
772	Robot initialization finished	780	Reserved	788	Bit 4 in status area	796	Bit 12 in status area
773	Auto mode	781	Reserved	789	Bit 5 in status area	797	Bit 13 in status area
774	External mode	782	Command process finished	790	Bit 6 in status area	798	Bit 14 in status area
775	Battery warning	783	Status area odd parity	791	Bit 7 in status area	799	Bit 15 in status area

No.	Content	No.	Content			No.	Content
800	OUTPUT 800	808	OUTPUT 808			1016	OUTPUT 1016
801	OUTPUT 801	809	OUTPUT 809			1017	OUTPUT 1017
802	OUTPUT 802	810	OUTPUT 810			1018	OUTPUT 1018
803	OUTPUT 803	811	OUTPUT 811			1019	OUTPUT 1019
804	OUTPUT 804	812	OUTPUT 812			1020	OUTPUT 1020
805	OUTPUT 805	813	OUTPUT 813			1021	OUTPUT 1021
806	OUTPUT 806	814	OUTPUT 814			1022	OUTPUT 1022
807	OUTPUT 807	815	OUTPUT 815			1023	OUTPUT 1023

Note 1: Numerals in the No. column denote the I/O port numbers of the controller.
Note 2: The output data is handled in bytes (8 points). The default is 56 points. Up to 256 points can be used.

8.3.2 Compatible Assignment Mode

(1) Input Data

No.	Content	No.	Content	No.	Content	No.	Content
512	Step stop (all tasks)	520	Program selection bit	528	Motor power ON	536	INPUT 536
513	Continue start	521	Bit 1 for program selection	529	CAL execution	537	INPUT 537
514	Halt (all tasks)	522	Bit 2 for program selection	530	–	538	INPUT 538
515	Operation ready start	523	Bit 3 for program selection	531	SP100	539	INPUT 539
516	Skip interrupt	524	Bit 4 for program selection	532	Switching to external mode	540	INPUT 540
517	Program start	525	Bit 5 for program selection	533	Program reset	541	INPUT 541
518	–	526	Bit 6 for program selection	534	Robot alarm	542	INPUT 542
519	–	527	Program selection parity	535	–	543	INPUT 543

No.	Content	No.	Content			No.	Content
544	INPUT 544	552	INPUT 552			760	INPUT 760
545	INPUT 545	553	INPUT 553			761	INPUT 761
546	INPUT 546	554	INPUT 554			762	INPUT 762
547	INPUT 547	555	INPUT 555			763	INPUT 763
548	INPUT 548	556	INPUT 556			764	INPUT 764
549	INPUT 549	557	INPUT 557			765	INPUT 765
550	INPUT 550	558	INPUT 558			766	INPUT 766
551	INPUT 551	559	INPUT 559			767	INPUT 767

Note 1: Numerals in the No. column denote the I/O port numbers of the controller.
Note 2: The input data is handled in bytes (8 points). The default value is 64 points. Up to 256 points can be used.

(2) Output Data

No.	Content	No.	Content	No.	Content	No.	Content
768	–	776	Robot power ON finished	784	Error code, unit, 2^0	792	Error code, hundreds, 2^0
769	Robot running	777	Servo ON	785	Error code, unit, 2^1	793	Error code, hundreds, 2^1
770	Robot alarm	778	CAL finished	786	Error code, unit, 2^2	794	Error code, hundreds, 2^2
771	Auto mode	779	Teaching	787	Error code, unit, 2^3	795	Error code, hundreds, 2^3
772	External mode	780	Single cycle end	788	Error code, tens, 2^1	796	–
773	Program start reset	781	Battery warning	789	Error code, tens, 2^2	797	–
774	–	782	Robot warning	790	Error code, tens, 2^3	798	–
775	–	783	Continue start permitted	791	Error code, tens, 2^4	799	–

No.	Content	No.	Content			No.	Content
800	OUTPUT 800	808	OUTPUT 808			1016	OUTPUT 1016
801	OUTPUT 801	809	OUTPUT 809			1017	OUTPUT 1017
802	OUTPUT 802	810	OUTPUT 810			1018	OUTPUT 1018
803	OUTPUT 803	811	OUTPUT 811			1019	OUTPUT 1019
804	OUTPUT 804	812	OUTPUT 812			1020	OUTPUT 1020
805	OUTPUT 805	813	OUTPUT 813			1021	OUTPUT 1021
806	OUTPUT 806	814	OUTPUT 814			1022	OUTPUT 1022
807	OUTPUT 807	815	OUTPUT 815			1023	OUTPUT 1023

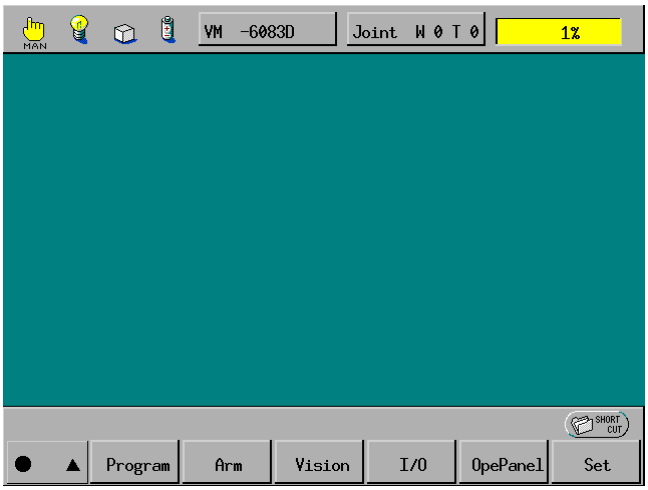
Note 1: Numerals in the No. column denote the I/O port numbers of the controller.
Note 2: The output data is handled in bytes (8 points). The default is 56 points. Up to 256 points can be used.

8.4 Parameter Entry Procedure

8.4.1 Entering the Number of Input/Output Slots

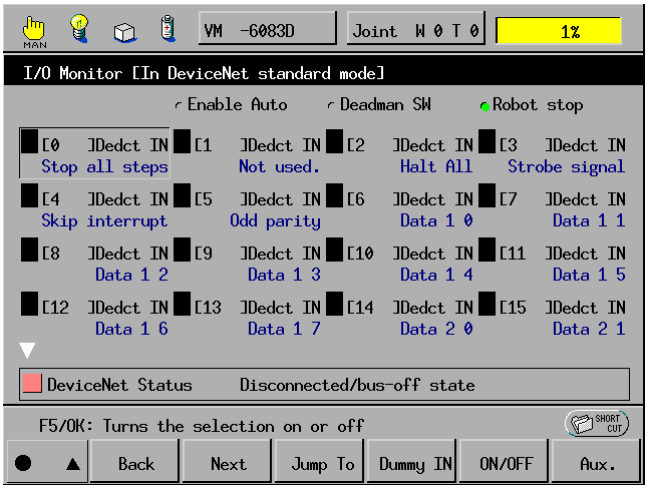
This controller allows you to increase or decrease the number of input/output slots in bytes. The number of input slots can be set in the range from 8 (default) to 32 (max.), and the number of output slots in the range from 7 (default) to 32 (max.). The setting procedure is given below:

Step 1 Press [F4 I/O] on the following screen.



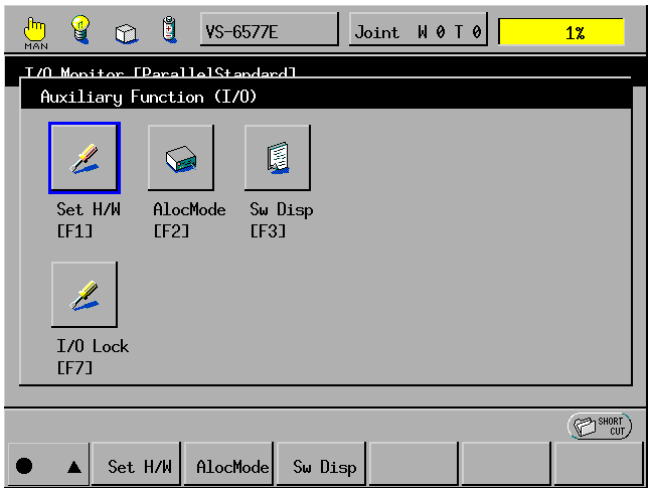
F4

Step 2 Press [F6 Aux.] on the following screen.


MAN
VM -6083D
Joint W 0 T 0
1%
I/O Monitor [In DeviceNet standard mode]
Enable Auto
Deadman SW
Robot stop
[0 Dedct IN Stop all steps
[1 Dedct IN Not used.
[2 Dedct IN Halt All
[3 Dedct IN Strobe signal
[4 Dedct IN Skip interrupt
[5 Dedct IN Odd parity
[6 Dedct IN Data 1 0
[7 Dedct IN Data 1 1
[8 Dedct IN Data 1 2
[9 Dedct IN Data 1 3
[10 Dedct IN Data 1 4
[11 Dedct IN Data 1 5
[12 Dedct IN Data 1 6
[13 Dedct IN Data 1 7
[14 Dedct IN Data 2 0
[15 Dedct IN Data 2 1
DeviceNet Status Disconnected/bus-off state
F5/OK: Turns the selection on or off
SHORT CUT
Back
Next
Jump To
Dummy IN
ON/OFF
Aux.

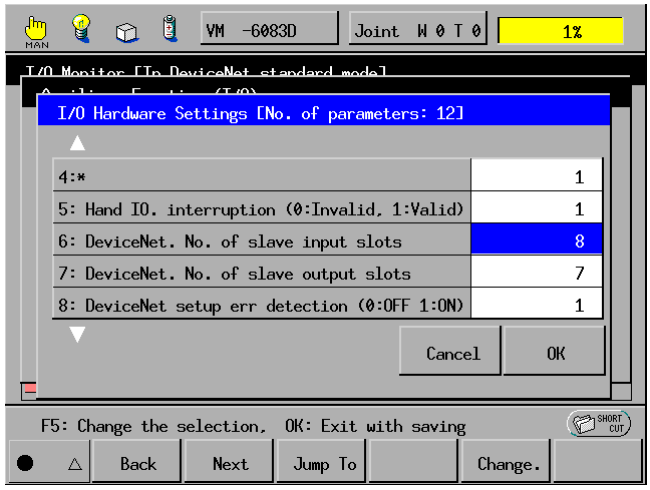
F6

Step 3 Press [F1 Set H/W] on the following screen.



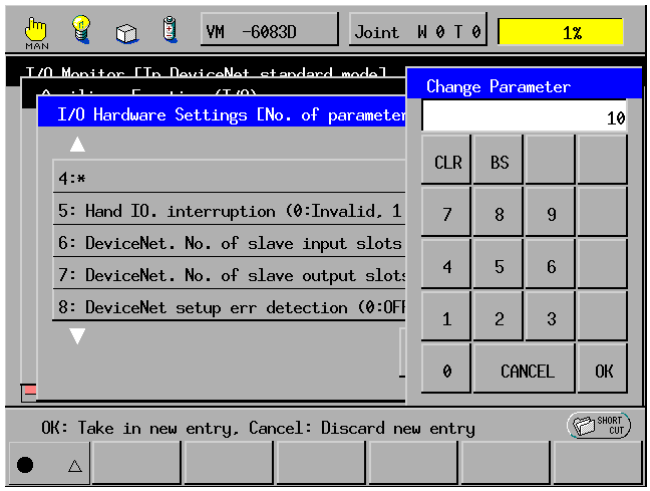
F1

Step 4 Select the box for changing the number of DeviceNet input/output slots and then press [F5 Change].

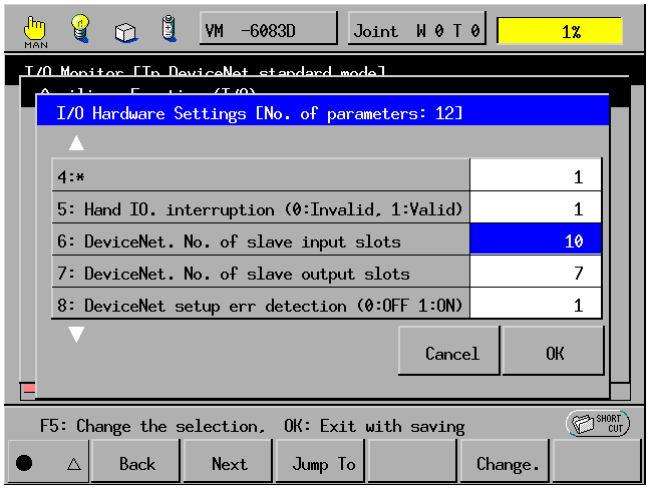


F5

Step 5 Enter a required number of slots on the following screen and press OK. The quick reference table given in the next subsection [2] will be helpful for you to determine the number of input/output slots.

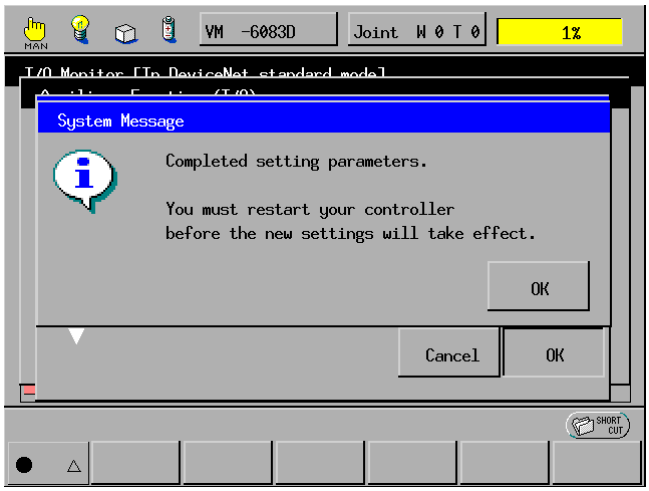


Step 6 Check that the number has been correctly changed (from 8 to 10 in this example) and press OK.



Step 7 Turn the controller power OFF and then turn it back ON according to the message on the following screen.

NOTE: The internal data that you have changed will not go into effect until you turn the controller power off and on.



8.4.2 Quick Reference Table for the Number of Input/Output Slots

The table below lists the correspondence between the number of input/output slots in DeviceNet and the number of user input/output points.

DeviceNet No. of input slots	Max. number of user input points		DeviceNet No. of output slots	Max. number of user output points	
	In standard assignment mode	In compatible assignment mode		In standard assignment mode	In compatible assignment mode
8	24	40	7	24	24
9	32	48	8	32	32
10	40	56	9	40	40
11	48	64	10	48	48
12	56	72	11	56	56
13	64	80	12	64	64
14	72	88	13	72	72
15	80	96	14	80	80
16	88	104	15	88	88
17	96	112	16	96	96
18	104	120	17	104	104
19	112	128	18	112	112
20	120	136	19	120	120
21	128	144	20	128	128
22	136	152	21	136	136
23	144	160	22	144	144
24	152	168	23	152	152
25	160	176	24	160	160
26	168	184	25	168	168
27	176	192	26	176	176
28	184	200	27	184	184
29	192	208	28	192	192
30	200	216	29	200	200
31	208	224	30	208	208
32	216	232	31	216	216
			32	224	224

8.5 Field Network Error Indication (Version 1.5 or later)

In Main Software Version 1.5 or later, the "10: FieldNetwork ErrDisplay" parameter is newly added to the I/O Hardware Settings window (Access: [F4 I/O]—[F6 Aux.]—[F1 Set H/W]). This parameter allows you to choose whether a network error will display "every time" it occurs or at the "first time."

This parameter takes effect in the DeviceNet masters and slaves and the PROFIBUS slaves.

The addition of this parameter disables the "8: DeviceNet Setup ErrDisplay" in the I/O Hardware Settings window.

This parameter is set to "0" (EveryTime) by default for safe operation of the facilities. Every time an I/O operation is carried out, an error will display if any.

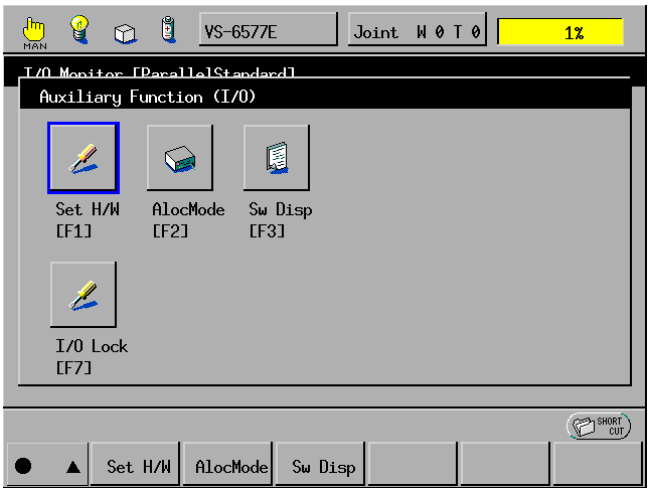
To check program operations using dummy I/Os for setting up facilities where no connection to the network has been established, set this parameter to "1" (First Time). Doing so will not display errors once detected, allowing you to check program operations.

NOTE: After completion of setting-up, be sure to set this parameter back to "0."

■ Changing the FieldNetwork ErrDisplay parameter

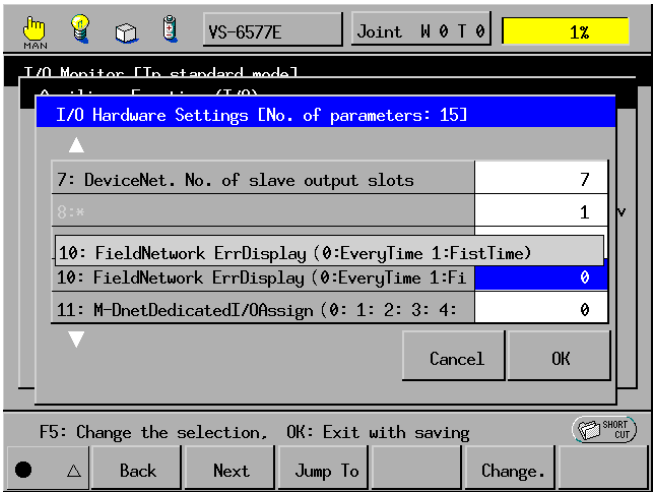
Access: [F4 I/O]—[F6 Aux.]—[F1 Set H/W]

Step 1 Press [F1 Set H/W] in the Auxiliary Function (I/O) window.



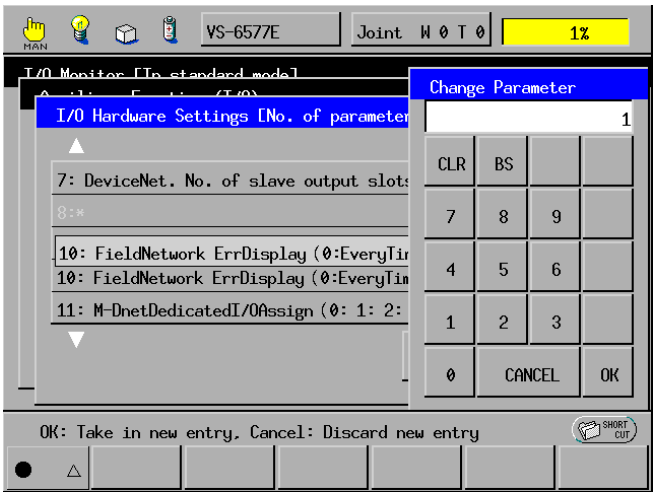
F1

Step 2 Select "10: FieldNetwork ErrDisplay" and press [F5 Change.].

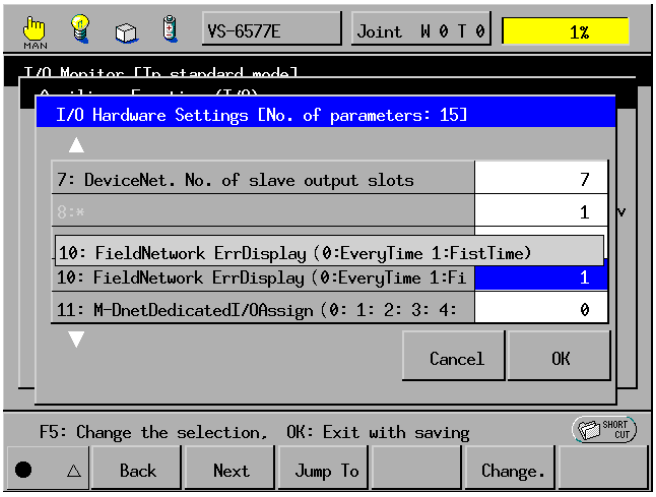


F5

Step 3 Enter "1" in this example and press [OK].



Step 4 Check the newly entered value and press [OK].



Step 5 Following the system message, switch the controller power off and then on.

NOTE: If this message appears, you must switch the controller off.

8.6 Network Error Detector Suppression (Version 1.7 or later)

If facilities are powered up, the network components will immediately start to establish connections between the master and slaves.

If connected as a slave, the robot controller will start to establish connection with the master (PLC). The time required for the establishment will differ depending upon manufacturers of masters.

Also if the robot controller RC5 equipped with DeviceNet master board is connected as a master with RC5 slaves, then the time required for establishing connections will vary depending upon differences between setting-up times of individual controllers.

If it takes long time to establish connection after the controller is turned on, then the controller system may interpret it as a network error. To prevent such a network error from occurring, Main Software Version 1.7 or later newly supports the network error detector suppression that suppresses the detector for the specified time after the controller is turned on.

You may set the suppression time length (from 0 to 65535 ms) to the "17: Insensitive time to network error (ms)" parameter in the I/O Hardware Settings window (Access: [F4 I/O]—[F6 Aux.]—[F1 Set H/W]).

The initial value of the parameter is 8000, meaning that no network error will be detected for 8 seconds after completion of controller initialization.

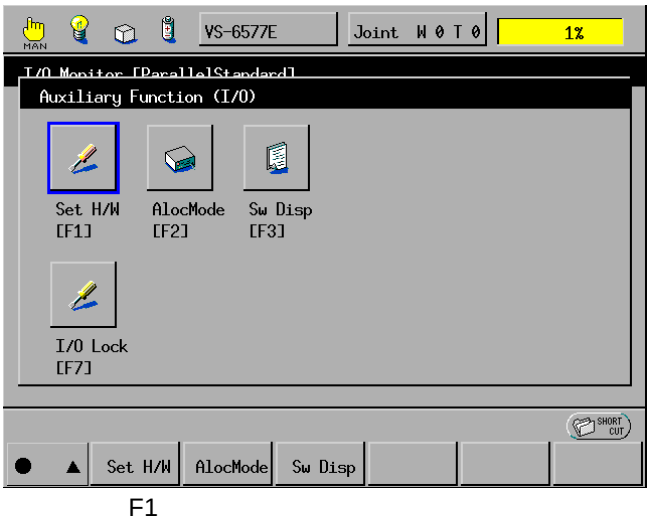
If a network error occurs when the controller is turned on, then it will be detected 8 seconds later.

This parameter takes effect only immediately after the controller is turned on. After that, it does not influence network error detection so that any network error will be detected the moment it occurs.

■ Changing the Network ErrDetection Suppression Time parameter

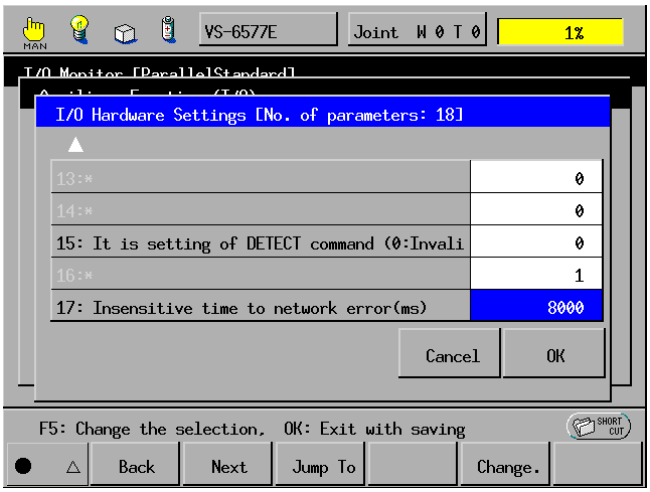
Access: [F4 I/O]—[F6 Aux.]—[F1 Set H/W]

Step 1 Press [F1 Set H/W] in the Auxiliary Function (I/O) window.



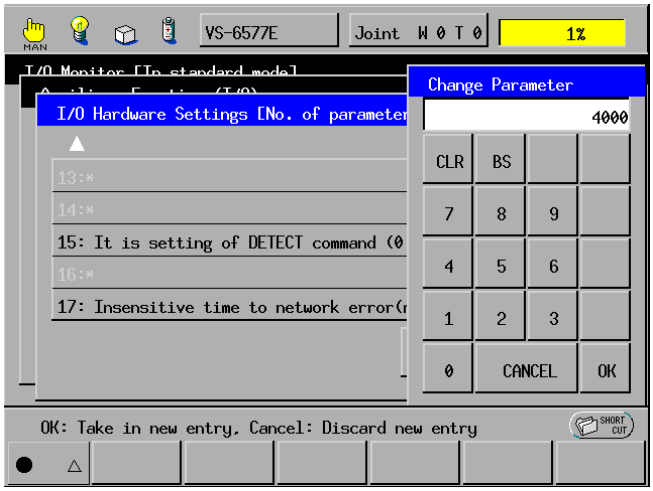
F1

Step 2 Select "17: Insensitive time to network error" and press [F5 Change.].

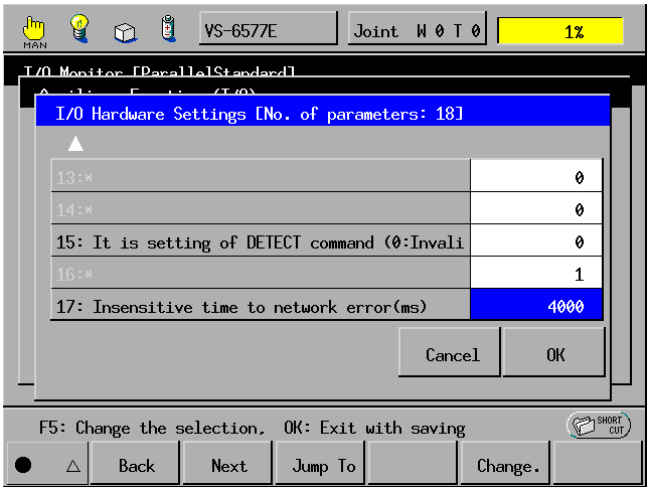


F5

Step 3 Enter "4000" in this example and press [OK].



Step 4 Check the newly entered value and press [OK].



Step 5 Following the system message, switch the controller power off and then on.

NOTE: If this message appears, you must switch the controller off.

8.7 Error Code Table

Here, only the error codes relative to DeviceNet communication errors are described in the table below. For other error codes, refer to the ERROR CODE TABLES, "2 Controller Error Code Table."

DeviceNet Error Code Table

Error code	What has happened:	What to do:	LEDs	
			MS	NS
1201	Preparing for communications (link not established) • The DeviceNet module is working normally, but has not established link with the master device.	Establish the link from the master device.	G	G
1202	Preparing for communications (link not established) • The DeviceNet module is working normally and has established explicit link with the master device, but not established an I/O link.	Establish the I/O link from the master device.	G	G
1203	Preparing for communications (communications idling) • The DeviceNet module is working normally, but cannot receive data except empty data from the master device.	Check the contents of I/O data that the master device sends.	G	G
1204	Preparing for communications (I/O timeout) • The DeviceNet module is working normally, but cannot receive data from the master device within the specified time.	Check that the DeviceNet cable is not broken or its connector is firmly plugged in. Check the DeviceNet cable length and that a terminator resistor is attached to each end of the trunk line.	G	R
1205	Initial setting error in the communications processor • Failed to establish the initial link with the DeviceNet communication processor.	Turn the controller power off and then on, and do the same operation again.	–	–
1210	A DeviceNet internal communications error has occurred.	Turn the controller power off and then on, and do the same operation again.	–	–
1213	The network is broken or "bus off." • The DeviceNet cable is broken or not connected.	Check whether the DeviceNet cable is connected with the robot controller. If this error occurs after you change the DIP switch setting, check whether the bit rate setting made with the DIP switch matches the network's bit rate.	G	R
1215	Preparing for communications (Initial setting error) • No initial settings have been received from the robot.	Check whether the bit rate setting made with the DIP switch matches the network's bit rate..	G	●
1216	Data length setting error • DeviceNet INSLOT or OUTSLOT is not 32 or less.	Turn the controller power off and then on. Then, set correct DeviceNet INSLOT and OUTSLOT values.	R	●
1217	Node address double-assign error • The same node address is double assigned to the robot controller and any other online node.	Assign an exclusive node address to each node (including the robot controller) on the same DeviceNet.	G	R

: ON : Flashing ● : OFF – : Indefinite

Error code	What has happened:	What to do:	LEDs	
			MS	NS
1230	Retry error in the DPRAM built in the robot controller	Turn the controller power off and then on, and do the same operation again.	–	–
1232	Reset command received • The robot controller has received a reset command from the master device.	Turn the controller power off and then on, and do the same operation again.	G	G
1234	DeviceNet internal RAM error	Turn the controller power off and then on, and do the same operation again.	R	●
1235	Reserved for System	–	R	●
1236	DeviceNet internal DPRAM error	Turn the controller power off and then on, and do the same operation again.	R	●
1237	DeviceNet EEPROM error	Turn the controller power off and then on, and do the same operation again.	R	●
1238	Retry error in the DeviceNet DPRAM	Turn the controller power off and then on, and do the same operation again.	R	●

: ON : Flashing ● : OFF – : Indefinite

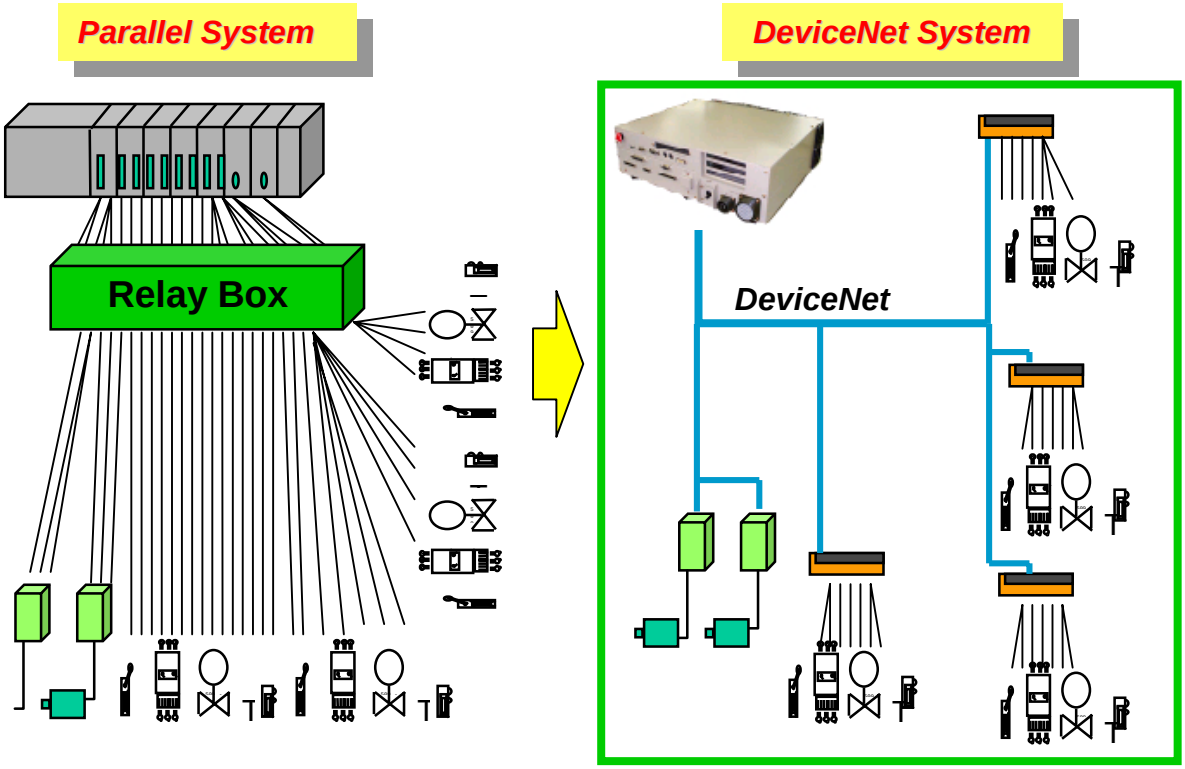
RC5 EDS File ($ DeviceNet Manager Generated Electronic Data Sheet)

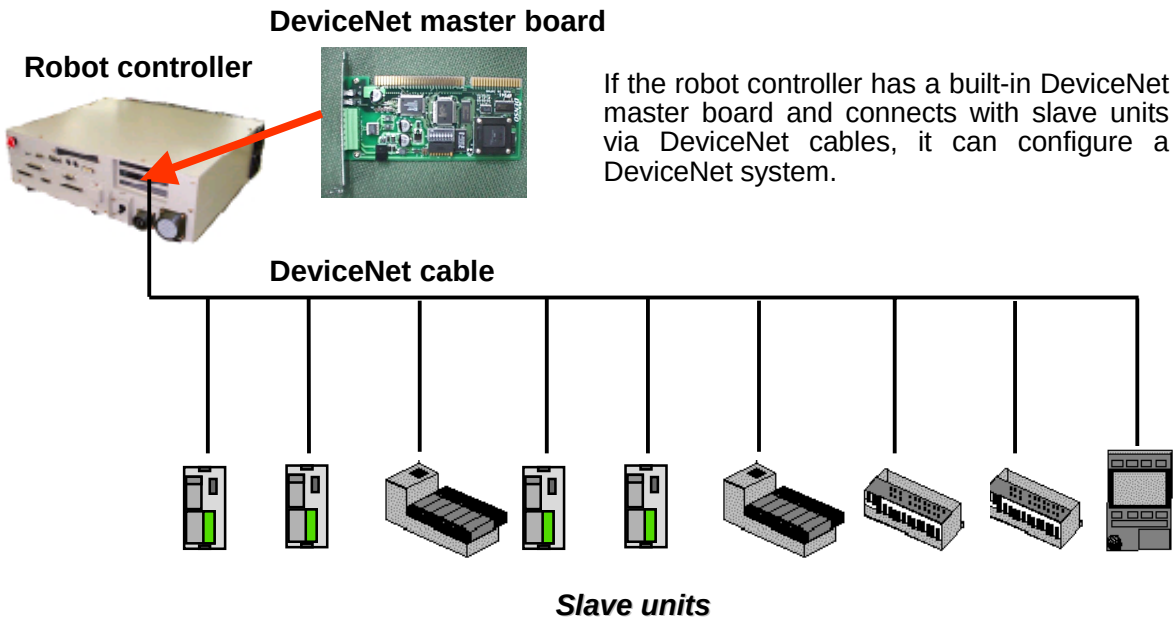
```
[File]
        DescText= "RC5 EDS File";
        CreateDate= 11-14-1997;
        CreateTime= 15:00:00;
        ModDate= 06-26-1999;
        ModTime= 10:57:07;
        Revision= 1.1;

[Device]
        VendCode        = 171;                  $ Vendor Code
        ProdType        = 12;                   $ Product Type
        ProdCode        = 1;                    $ Product Code
        MajRev          = 1;                    $ Major Rev
        MinRev          = 1;                    $ Minor Rev
        VendName        = "Denso Corporation";
        ProdTypeStr     = "Communication Adapter";
        ProdName        = "RC5";
        Catalog         = "";

[IO_Info]
        Default         = 0X0001;               $ Poll Only
        PollInfo        = 0X0001,               $ Poll Only
                          1,                    $ Default Input = Input1
                          1;                    $ Default Output = Output1

        $Input Connections
        Input1          =
                  7,                            $ From 7 to 32 Bytes, Variability
                  0,                            $ All bits are significant
                  0x0001,$ Poll Only Connection
                  "Data",                       $ Name
                  6,                            $ Path Length
                  "20 07 24 02 30 04",          $ Register Object Instance 2 Attribute 4
                  "Robot Output Data";          $ Help

        $Output Connections
        Output1         =
                  8,                            $ From 8 to 32 Bytes, Variability
                  0,                            $ All bits are significant
                  0x0001,$ Poll Only Connection
                  "Data",                       $ Name
                  6,                            $ Path Length
                  "20 07 24 01 30 04",          $ Register Object Instance 1 Attribute 4
                  "Robot Input Data";           $ Help
```

Chapter9 DeviceNet Master Board

9.1 Overview

DeviceNet is a serial communication system that makes it easy to interconnect control devices such as PLCs, computers, sensors, and actuators. DeviceNet sharply cuts cost in wiring and allows connection of DeviceNet-compliant devices of various manufacturers, enabling cost-effective and convenient system construction.





If the robot controller has a built-in DeviceNet master board and connects with slave units via DeviceNet cables, it can configure a DeviceNet system.

9.1.1 Features

(1) DeviceNet-compliant

The DeviceNet is an internationally open network developed by Allen-Bradley and is designed to allow control devices (e.g., sensors and actuators) to communicate with each other.

(2) Can be networked with control devices of various manufacturers

The robot controller equipped with DeviceNet master board can be networked with DeviceNet-compliant control devices of various domestic and foreign manufacturers since the communications specifications are open.

(3) Easy wiring and maintenance

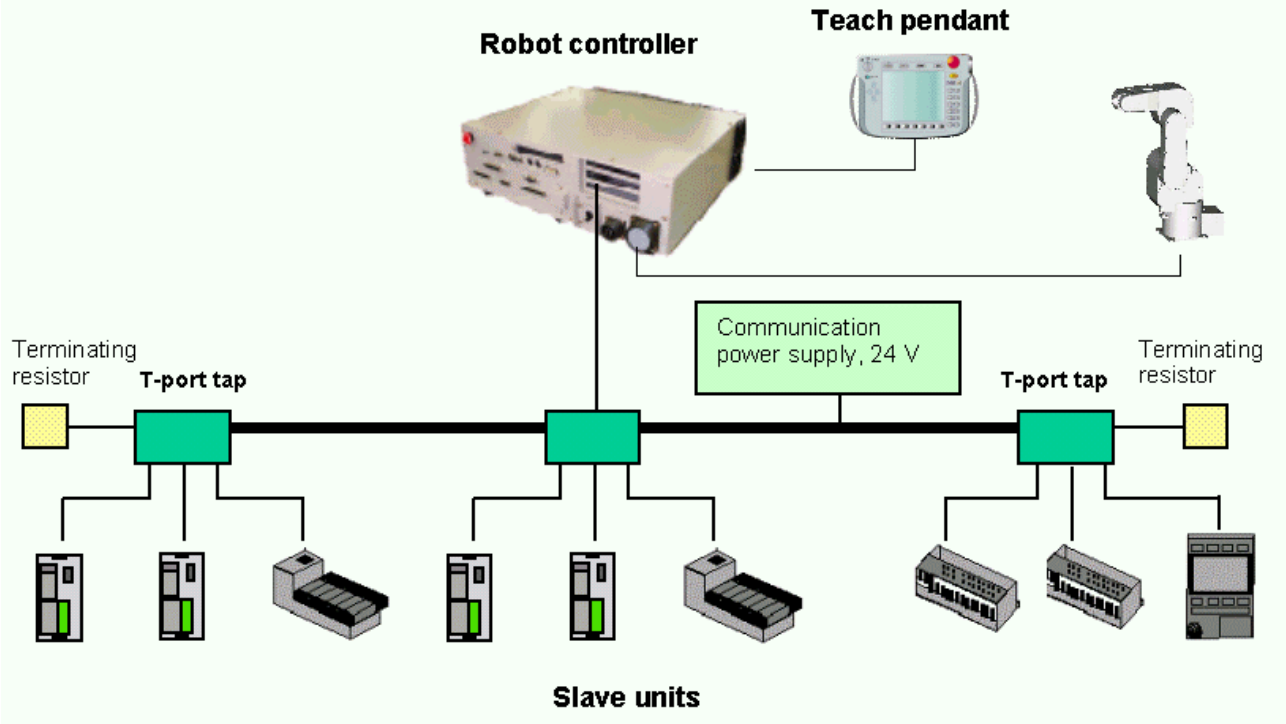
The 5-core special cable and detachable connector of the DeviceNet master board make it easy to install wiring between nodes (communications units) and disassembly/restructure the network. This will sharply reduce cost in wiring and maintenance, as well as making replacement of units easy at the time of failure.

(4) Sufficient number of I/Os

This controller is capable of handling a large volume of transmitted and received data, with up to 1024 input contacts and 1024 output contacts.

With the teach pendant, you may scan the network without using a dedicated configurator so as to easily rearrange connected slave units.

9.1.2 System Configuration Sample



9.1.3 System Construction Procedure

(1) First, connect the master and slave devices with each other by using DeviceNet cables, referring to the system configuration sample. It is essential to connect terminating resistors. The power supply for communications should not be turned on at this stage.

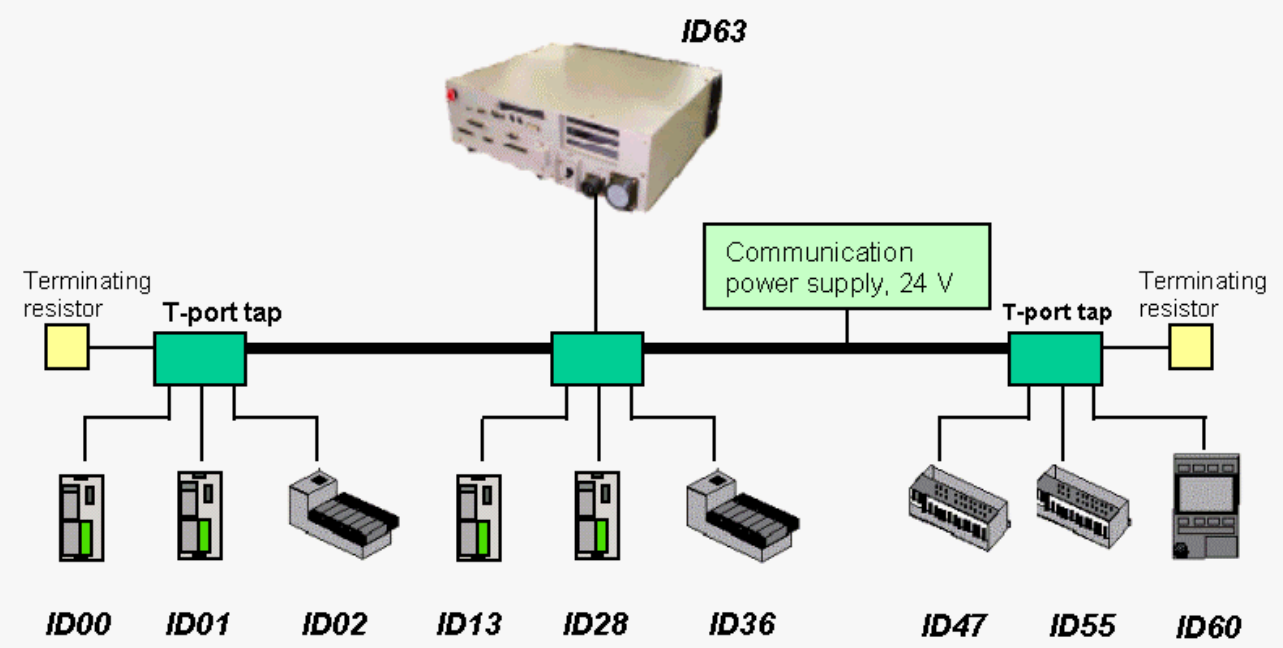
(More details about wiring and system configuration are described in Subsection 9.2.2 and in Section 9.4, respectively.)

(2) Set the communications speed for master and slave devices. DeviceNet allows selection of 125, 250, or 500 Kbps. The factory default is 500 Kbps.

(Wrong speed setting will make communications impossible.)

(3) Set the addresses of the master and slave devices. In DeviceNet, as shown below, a total of 64 master and slave devices can be connected, and each device must be assigned any of ID addresses ranging from 0 to 63.

(Take care not to double-assign a same address on the same network.)



(4) After setting up the communications speeds and addresses, connect the communication power supply and then turn on the power of each device. This completes the hardware settings.

(5) Register the information about the connected slave devices to the master device. This registration information is called “scanlist.” According to the scanlist, the master device may control those slave devices.

For the procedure on how to create a scanlist, refer to Subsection 9.4.2.

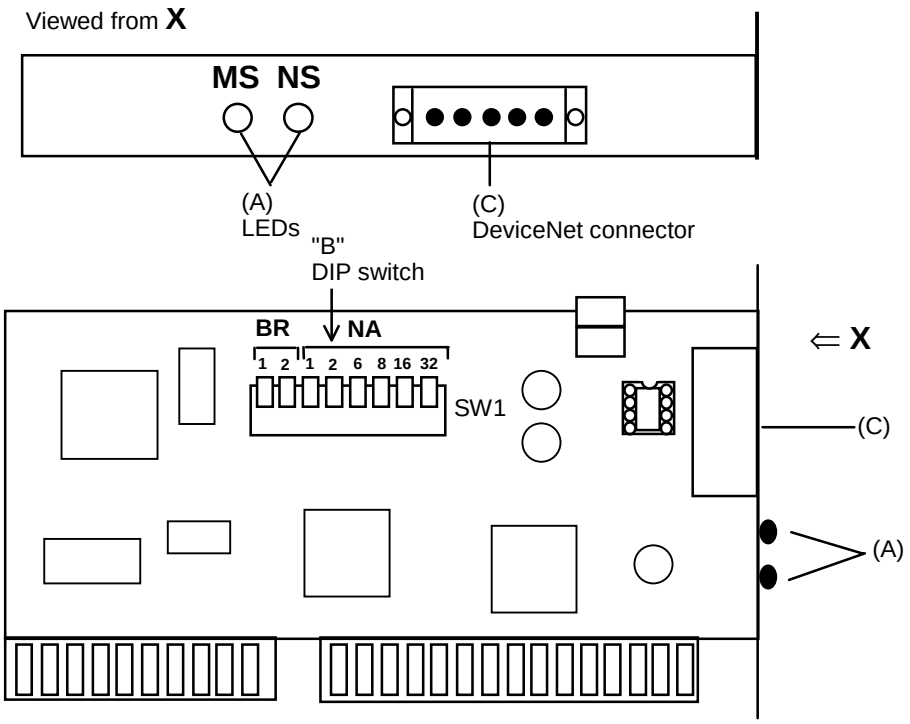
(6) The creation of the scanlist will automatically determine I/O addresses for the connected slave devices. Accordingly, the I/O communication between the master and slave devices becomes possible. The input and output areas of the master device from/to slave devices are IO [1024] to [2047] and IO [2048] to [3071], respectively.

(For details about I/O addresses, refer to Section 9.3.)

9.2 Product Specifications

The figure below shows the location of the LEDs, DIP switches, and DeviceNet connector on the DeviceNet master board.

9.2.1 Names and Functions of Master Board Components



(A) Status indicator LEDs

The status indicators MS and NS ("A" in the figure given on the previous page) can light or flash in green or red. Each of the ON, flashing, and OFF states of those indicators shows the module or network status as listed below.

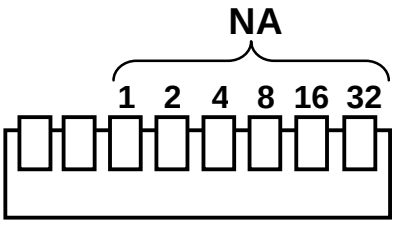
The flashing interval is once per second (0.5 second of ON and 0.5 second of OFF).

LED Name	Color	Status	Status Definition	Meaning (Main Errors)
MS (Module Status)	Green	☼	Normal state	• The device is working normally.
		◐☼	Setup not completed	• The setting is incorrect and must be adjusted.
	Red	☼	Fatal error	• A device hardware error has occurred.
		◐☼	Recoverable error	• An error from which recovery is possible has occurred.
	–	●	No power supplied	• Device power is not being supplied.
NS (Network Status)	Green	☼	Communications link established	• The network is normal (communication has been established).
		◐☼	Communications link not established	• The network is normal but communication with the slaves has not been established.
	Red	☼	Fatal communications error	• Communication is not possible due to an error such as allocation of the same address to more than one node, or detection of Busoff.
		◐☼	Recoverable communications error	• Communication is not possible due to an error such as a slave size error.
	–	●	Offline	• The online status cannot be established, e.g. because a CAN send timeout error has occurred.

☼ : ON ◐☼ : Flashing ● : OFF

(B) DIP switch (SW1)

Use the DIP switch for setting the node address and bit rate as shown below.



Viewed from top

NOTE: Always turn off the controller power (including the network power) before setting the DIP switch.

Setting the node address

Set the node address of the robot controller using selectors (NA) of the DIP switch, referring to the table below. You may freely set any of 0 through 63 to a node address unless the address is double-assigned on the same network including the master and slaves. Double assignment will cause an address double-assignment error, disabling the network.

DIP Switch						Node Address	DIP Switch						Node Address
1	2	4	8	16	32		1	2	4	8	16	32	
0	0	0	0	0	0	0	0	1	1	0	1	0	22
1	0	0	0	0	0	1	1	1	1	0	1	0	23
0	1	0	0	0	0	2	0	0	0	1	1	0	24
1	1	0	0	0	0	3	1	0	0	1	1	0	25
0	0	1	0	0	0	4	0	1	0	1	1	0	26
1	0	1	0	0	0	5	1	1	0	1	1	0	27
0	1	1	0	0	0	6	0	0	1	1	1	0	28
1	1	1	0	0	0	7	1	0	1	1	1	0	29
0	0	0	1	0	0	8	0	1	1	1	1	0	30
1	0	0	1	0	0	9	1	1	1	1	1	0	31
0	1	0	1	0	0	10	0	0	0	0	0	1	32
1	1	0	1	0	0	11	1	0	0	0	0	1	33
0	0	1	1	0	0	12	0	1	0	0	0	1	34
1	0	1	1	0	0	13	1	1	0	0	0	1	35
0	1	1	1	0	0	14	0	0	1	0	0	1	36
1	1	1	1	0	0	15	1	0	1	0	0	1	37
0	0	0	0	1	0	16	0	1	1	0	0	1	38
1	0	0	0	1	0	17	1	1	1	0	0	1	39
0	1	0	0	1	0	18	0	0	0	1	0	1	40
1	1	0	0	1	0	19	1	0	0	1	0	1	41
0	0	1	0	1	0	20	0	1	0	1	0	1	42
1	0	1	0	1	0	21	1	1	0	1	0	1	43

(continued on the following page)

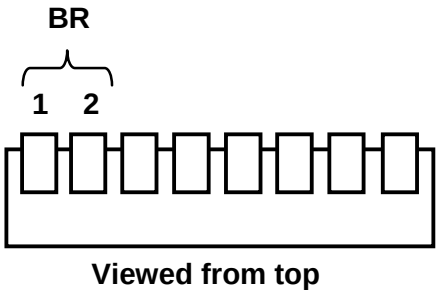
DIP Switch						Node Address	DIP Switch						Node Address
1	2	4	8	16	32		1	2	4	8	16	32	
0	0	1	1	0	1	44	0	1	1	0	1	1	54
1	0	1	1	0	1	45	1	1	1	0	1	1	55
0	1	1	1	0	1	46	0	0	0	1	1	1	56
1	1	1	1	0	1	47	1	0	0	1	1	1	57
0	0	0	0	1	1	48	0	1	0	1	1	1	58
1	0	0	0	1	1	49	1	1	0	1	1	1	59
0	1	0	0	1	1	50	0	0	1	1	1	1	60
1	1	0	0	1	1	51	1	0	1	1	1	1	61
0	0	1	0	1	1	52	0	1	1	1	1	1	62
1	0	1	0	1	1	53	1	1	1	1	1	1	63

0: OFF 1: ON

NOTE: The settings must be made with the controller power (including the network power supply) OFF. The factory default of the node address of the controller is “63.”

Setting the bit rate

To match the bit rate of the robot controller with that of the network, use selectors (BR) of the DIP switch, referring to the table below:



Viewed from top

Bit Rate Setting By DIP Switch

DIP Switch		Bit Rate
Selector 1	Selector 2	
0	0	125 Kbps
1	0	250 Kbps
0	1	500 Kbps
1	1	500 Kbps

0: OFF 1: ON

NOTE: This setting must be made with the controller power (including the network power supply) OFF. The factory default of the communications speed is 500 Kbps.

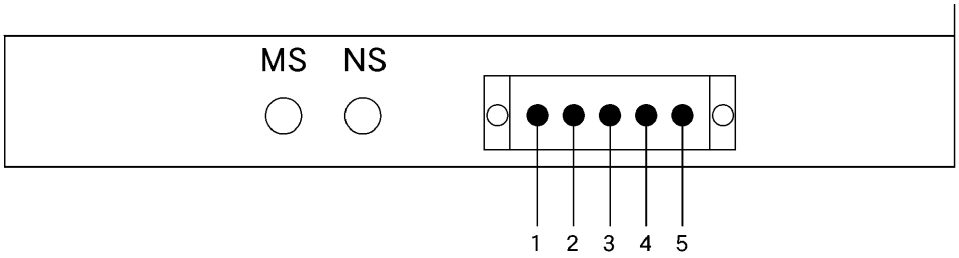
Set the same communications speed at all nodes (master and slave) throughout the network.

If a slave has a different communications speed from the master, the slave will not be able to participate in communications and it will cause communication errors at nodes where the correct communications speed is set.

(C) DeviceNet connector

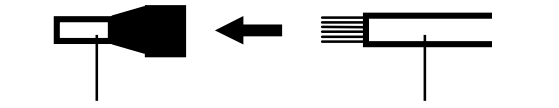
The robot controller uses an open screw connector whose pin arrangement is shown below.

NOTE: When the controller power (including the network power) is on, do not disconnect/connect the communication connector or touch its pins. Doing so will result in a failure.



1－V	Black
2－CAN_L	Blue
3－Drain	Shield
4－CAN_H	White
5－V＋	Red

You are recommended to use solderless terminals of the type shown below on the cables to be connected.



Crimp the solderless terminal after inserting the communication cable into it.

- Solderless terminals: AI series from Phoenix Contact
- Dedicated tool: ZA3 from Phoenix Contact

Or alternatively:

- Solderless terminals: TC series from Nichifu
  For thin cables: TME TC-0.5
  For thick cables: TME TC-2-11 (for power supply)
  TME TC-1.25-11 (for communications)
- Dedicated tool: NH-32

9.2.2 General Specifications

(1) Environmental requirements

Item	Specifications
Power requirements	5 VDC (supplied via the controller ISA bus)
Operating temperature	0 to 40°C
Operating humidity	90% RH or less (without condensation)

(2) DeviceNet communications specifications

Item	Specifications			
Communications protocol	DeviceNet–compliant			
Connection supported	- Polling I/O function - Bit strobe function Compliant with DeviceNet communication rules			
Connection type **(Note 1)**	Multi-drop type with possible combination of T-branch (to trunk and branch lines)			
Bit rate	500, 250, 125 kbps (selectable by switch)			
Communications media	Special cable consisting of 5 wires (2 for signals, 2 for power supply, and 1 as a shield wire)			
Communications cable length	Bit rate	Max. network length	Branch length	Total branch length
	500 kbps	100 m or less **(Note 2)**	6 m or less	39 m or less
	250 kbps	250 m or less **(Note 2)**	6 m or less	78 m or less
	125 kbps	500 m or less **(Note 2)**	6 m or less	156 m or less
Power supply for communication	External supply of 24 VDC ±10%			
Internal power consumption	Communication power source: 30 mA max.			
Max. number of connectable nodes	64			
Number of I/Os	- Input 1024 points - Output 1024 points			
Error check	CRC			

(Note 1) Terminator resistors are needed at both ends of the trunk cable.

(Note 2) These values may apply when a special thick cable is used as a trunk line. If a special fine cable is used, the max. network length is 100 m or less.

9.3 ALLOCATING I/O AREAS

9.3.1 I/O Allocation When a DeviceNet Master Board is Installed

If a DeviceNet master board is installed to the robot controller, the robot I/O areas will be allocated as listed below.

When the robot controller leaves the factory, both the parallel I/O areas and DeviceNet master I/O areas are allocated as user-I/O ports, except hand I/Os and I/Os numbered 72, 73, and 74.

You may enable or disable system-I/Os of parallel I/O areas with the teach pendant.

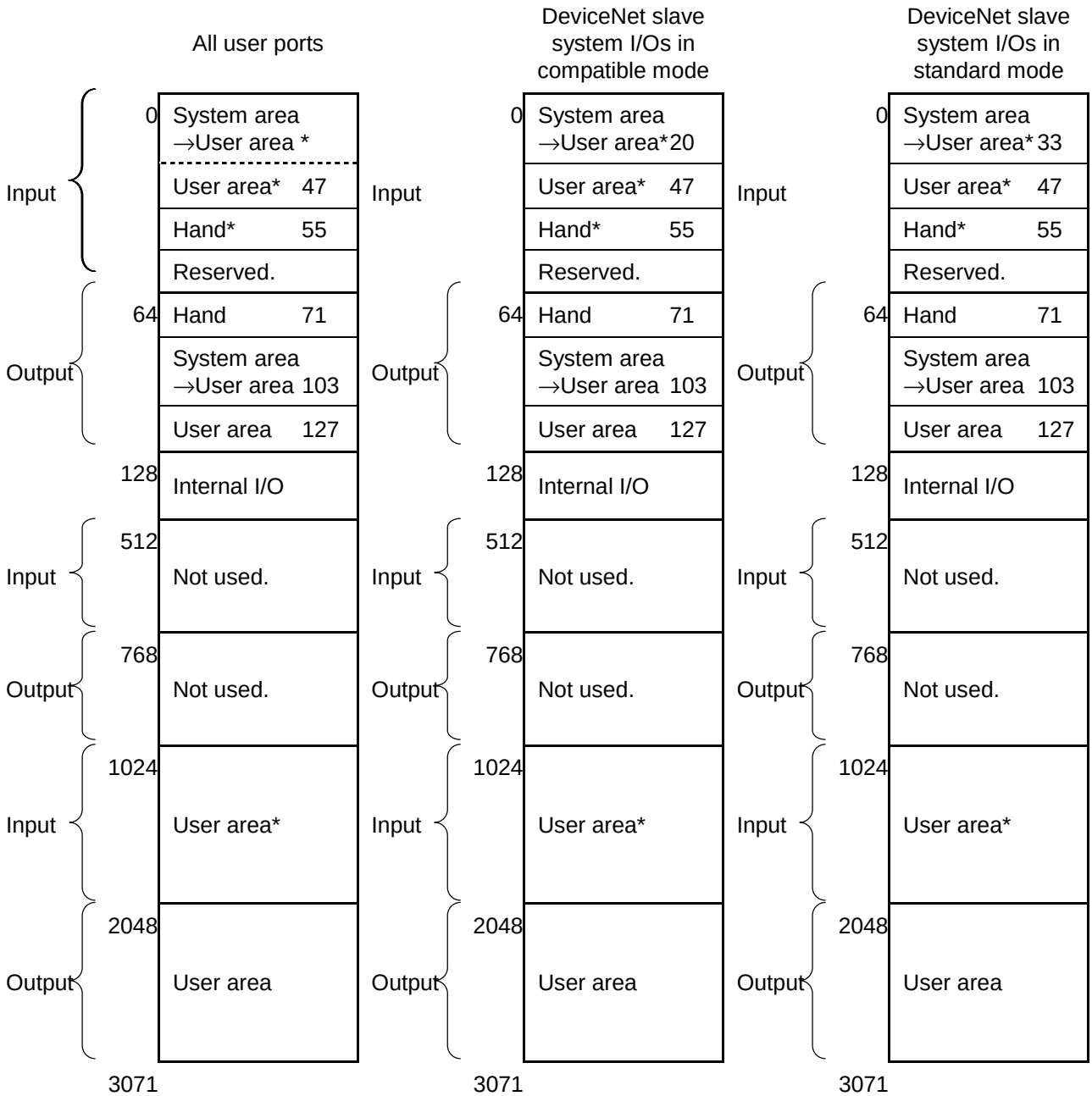
Robot I/O Areas when a DeviceNet Master Board is Installed

I/O Number	Main group	Sub group	Remarks
0	Parallel input area	User (dedicated) input	On shipment from the factory, this area is allocated as user input ports. It can be reallocated as a system input area with the teach pendant.
		User inputs	For details about parallel interface, see the “RC5 CONTROLLER INTERFACE MANUAL."
		Hand inputs	
64	Parallel output area	User (dedicated) outputs	On shipment from the factory, this area is allocated as user output ports. Note that I/Os numbered 72 (“CPU normal”), 73 (“robot running”), and 74 (“robot error”) are reserved as system output areas. The user output area can be reallocated as a system output area with the teach pendant.
		User outputs	For details about parallel interface, see the “RC5 CONTROLLER INTERFACE MANUAL."
		Hand outputs	
128	Internal I/O area	User inputs	This is the internal data memory area for the robot controller. It is used for temporary data storage, for flags used during robot internal tasks, and so on. Note that the data will be lost when the power goes off.
512	DeviceNet slave input area	Not for user use	This area is not allowed for users when a DeviceNet master board is connected.
768	DeviceNet slave output area	Not for user use	This area is not allowed for users when a DeviceNet master board is connected.
1024	DeviceNet master input area	User inputs	Signals sent from the slaves connected in the DeviceNet network will be inputted to this area.
2048	DeviceNet master output area	User outputs	Signals to be sent to the slaves connected in the DeviceNet network will be outputted to this area.
3071			

9.3.2 Allocation of System Ports

When using a DeviceNet master board, you may choose a system port allocation from the following five patterns. For the choosing procedure, refer to Subsection 9.4.6 “Allocating Ports Dedicated to the DeviceNet Master.”

Note that “Allocation of DeviceNet slave system I/Os in compatible mode” and “Allocation of DeviceNet slave system I/Os in standard mode” are reserved for future expansion, so their allocations are the same as that of “All user ports.”

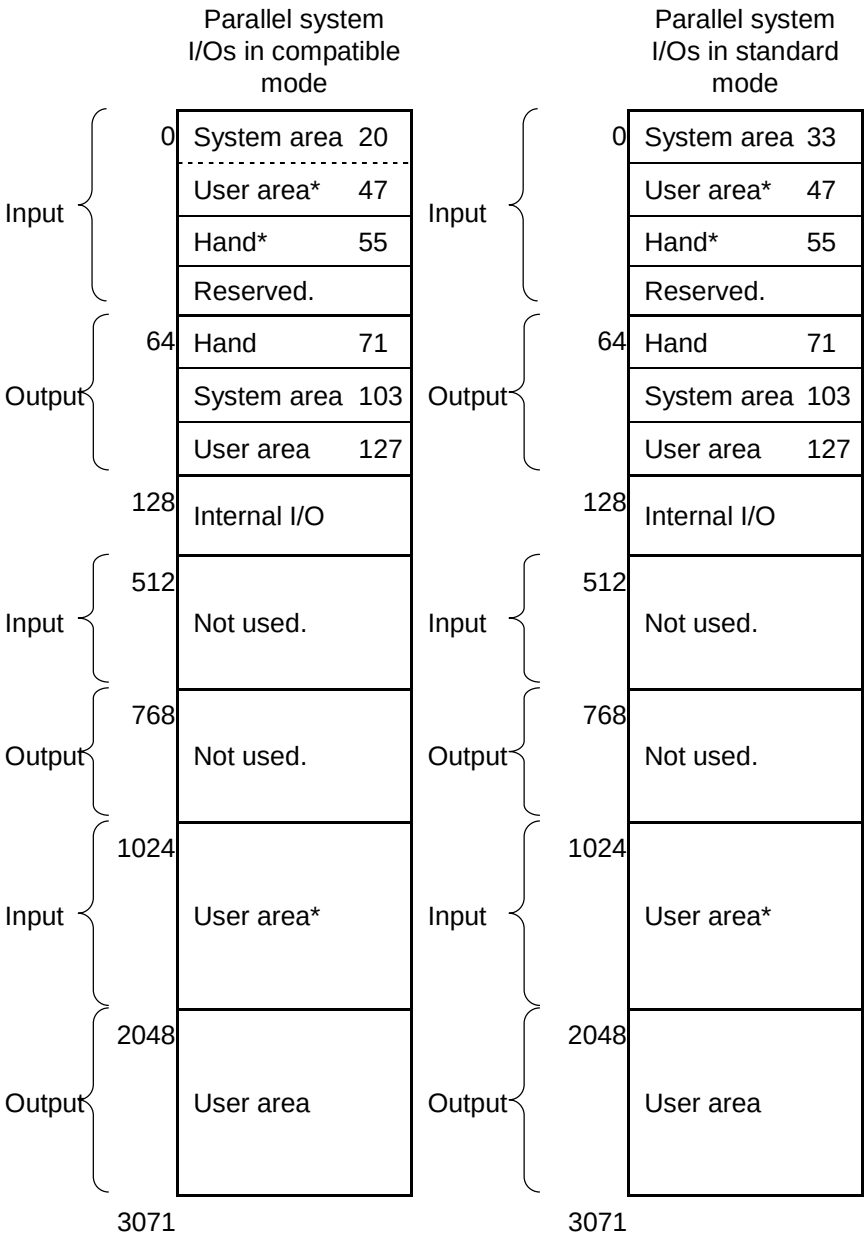


72: CPU normal
73: Robot running
74: Robot error

These are set by the system output and exist regardless of the mode.

Other system I/O areas will be used as user areas.

* Dummy I/O settings are only valid in user input and hand input areas.

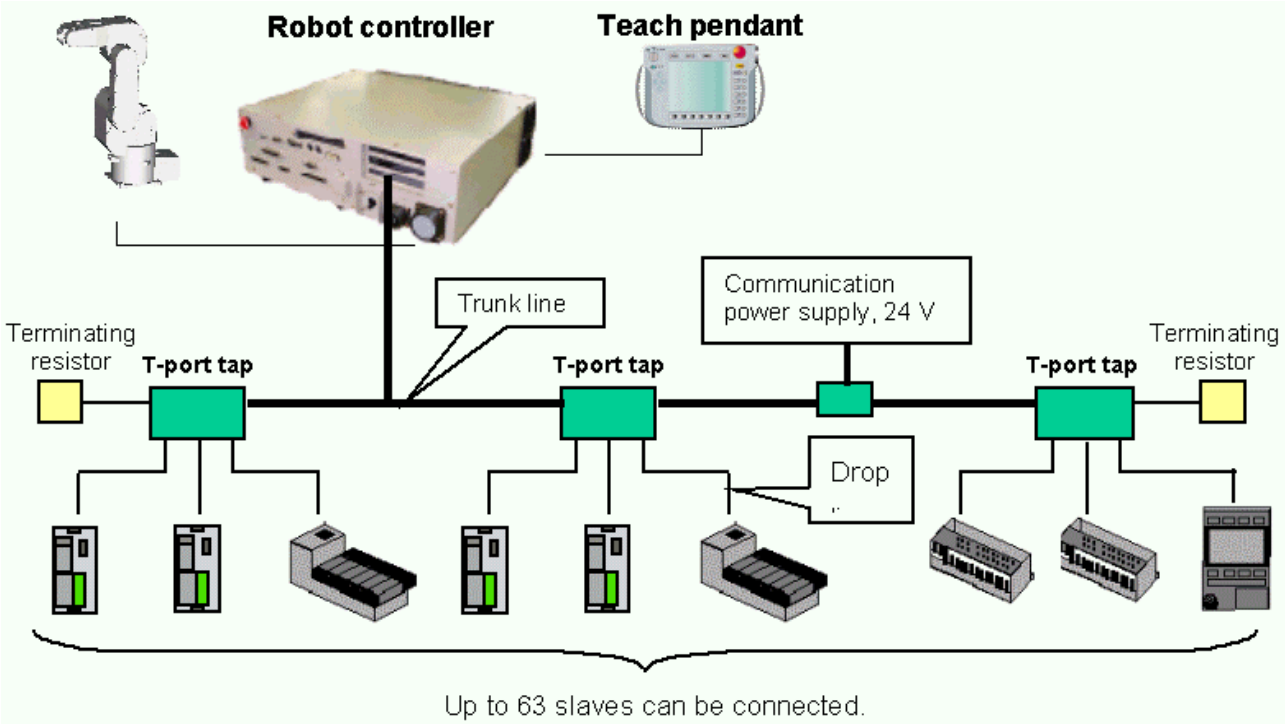


NOTE: For information on signals in the system I/O areas, refer to the RC5 CONTROLLER INTERFACE MANUAL.

* Dummy I/O settings are only valid in the user input and hand input areas.

9.4 Building Up a DeviceNet Network

9.4.1 Network Configuration Sample and Configurators



Nodes

A DeviceNet network has two kinds of nodes: slaves to which external I/Os are connected, and a master that controls these slaves. Note that their addresses are just network settings, so the master and slaves can be freely arranged on physical sites.

Trunk lines and drop lines

The trunk line is a cable whose both ends are terminated with resistors.

A drop line is a cable that branches off the trunk line.

The trunk line and drop lines can be constructed using DeviceNet thick cables, DeviceNet thin cables, or both.

Thick cables are used for long-distance trunk lines, strong trunk lines, and drop lines.

Thin cables are used for trunk lines and drop lines, and for easy termination processing.

Terminating resistors

Terminating resistors must be connected at both ends of the trunk line in a DeviceNet system. The specifications of the terminating resistors are listed below.

- 121 Ω
- Metal film resistor with resistance error of less than 1%
- 1/4 W

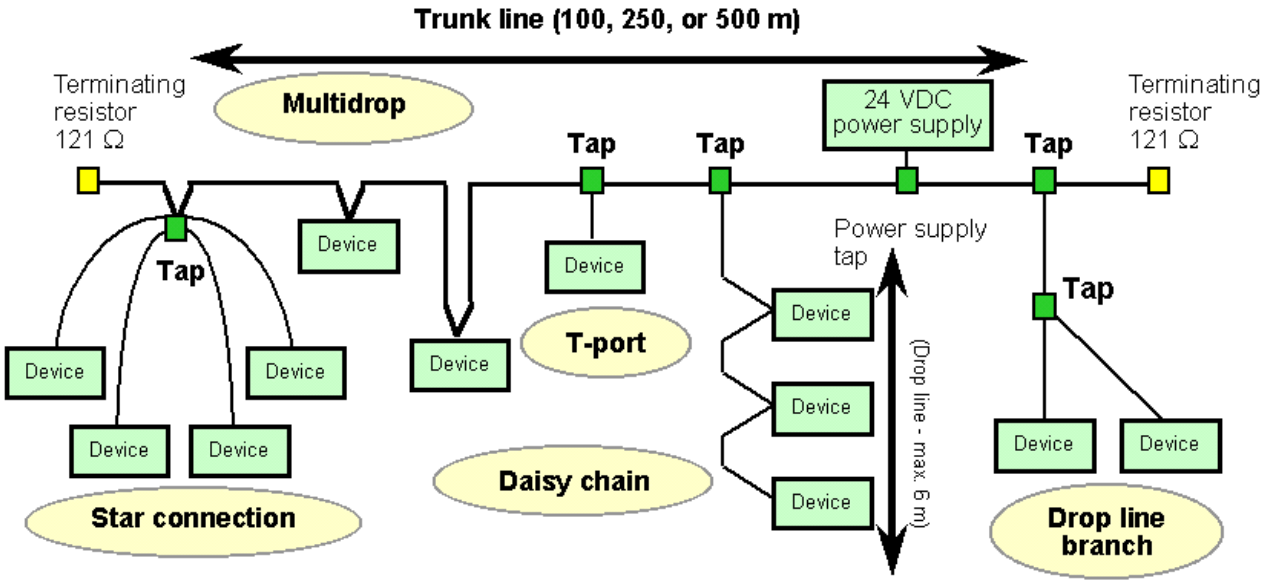
Never connect a terminating resistor to a node. This may result in a failure.

Communication power supply

To operate a DeviceNet network, a communication power must be supplied to each node through DeviceNet cables. The communication power supply, internal circuit power supply, and I/O power supply should be supplied separately.

Connection style

As shown below, a variety of connection styles are available for DeviceNet. They include multidrop, star connection, T-ports, daisy chain, and drop line branching.



Trunk line length

The permissible total length of a trunk line used in a DeviceNet network will differ depending upon the data transmission speed and the type of cables used (thick cable or thin cable).

Communications speed	Maximum cable length when only thick cables are used	Maximum cable length when only thin cables are used
125 Kbps	500 m	100 m
250 Kbps	250 m	
500 Kbps	100 m	

A DeviceNet network may be constructed with thick and thin cables together. In such a case, the permissible total lengths of thin and thick cables can be obtained according to the calculation formulae below.

Communications speed	Maximum network length
125 Kbps	L (thick) + 5 × L (thin) ≤ 500 m
250 Kbps	L (thick) + 2.5 × L (thin) ≤ 250 m
500 Kbps	L (thick) + L (thin) ≤ 100 m

"L (thick)" indicates the length of thick cables.
"L (thin)" indicates the length of thin cables.

Drop line length

The drop line length is cable distance between the trunk line tap and the farthest node on the drop line. The permissible overall length of drop lines throughout the network ("total length") depends on the communications speed, and must be within the lengths listed in the table below.

Communications speed	Drop line length	
	Maximum length	Overall length
125 Kbps	6 m	156 m
250 Kbps		78 m
500 Kbps		39 m

9.4.2 Creating a Scanlist

What is “scanlist”?

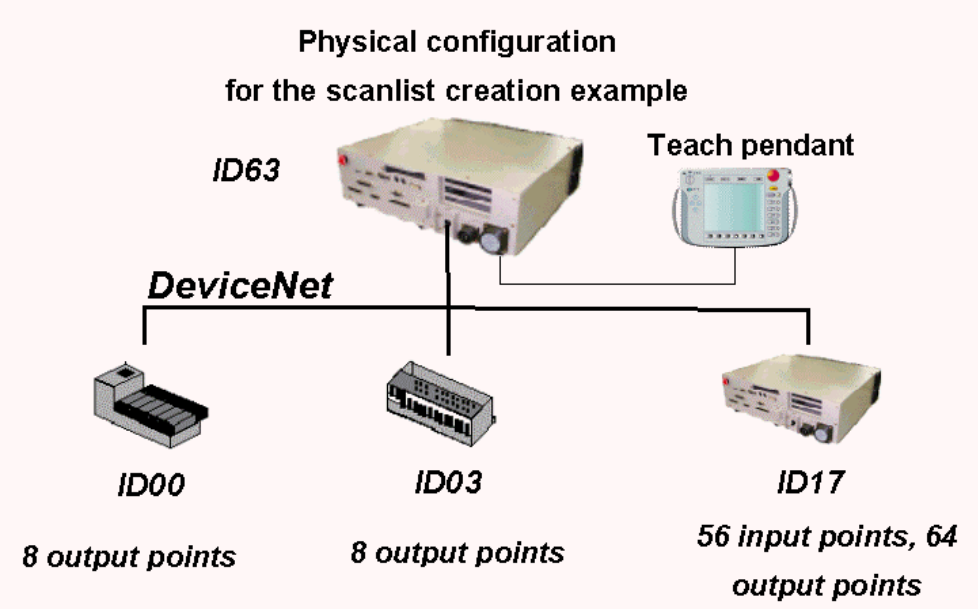
A scanlist is a parameter list that allows a DeviceNet master to identify slaves that are under its control during communication. Network communications are not possible without a scanlist.

The scanlist contains the following information:

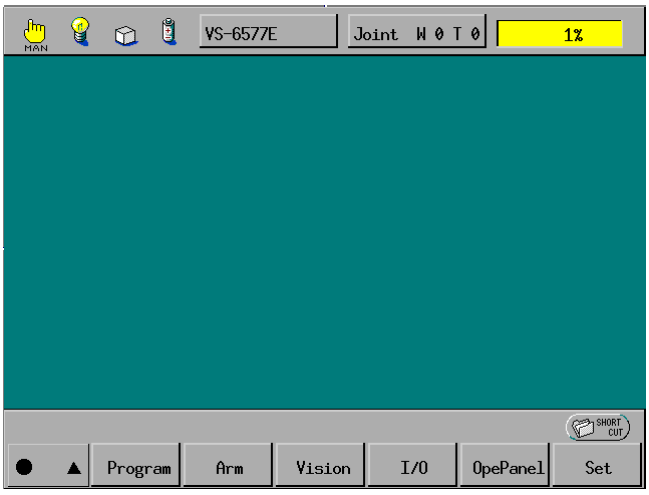
- Slave I/O allocation information (which slaves have how many input points, and which node addresses they occupy)
- The communication parameter information (remote I/O communications status, communication cycle time setting)

When creating a scanlist with the robot controller, you may choose either of the fixed I/O allocation mode (default) and free I/O allocation mode.

Scanlist creation procedure



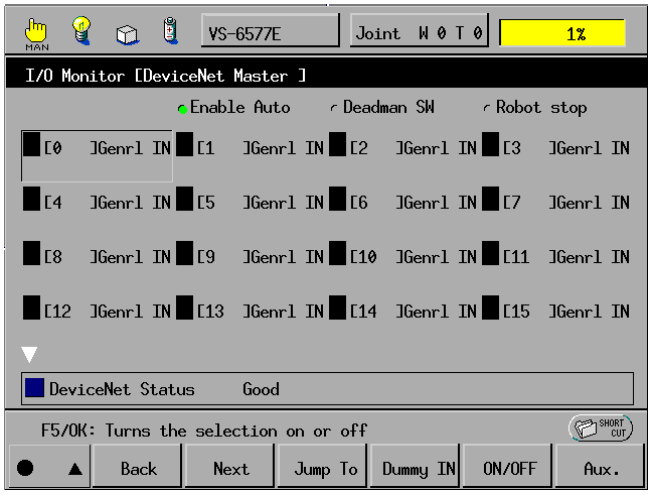
Step 1 On the top screen of the teach pendant, press [F4 I/O].



F4

Step 2

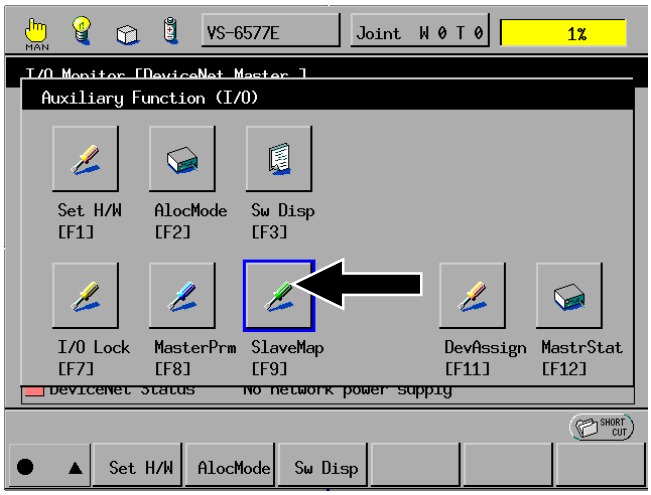
On the following screen, press [F6 Aux.].



F6

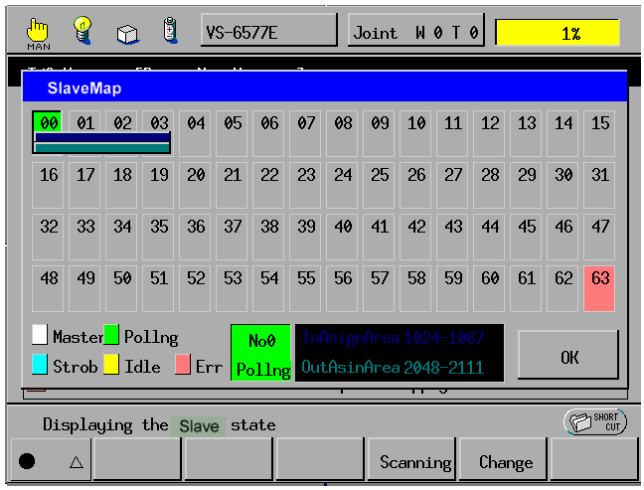
Step 3

Press [F9 SlaveMap].



Step 4

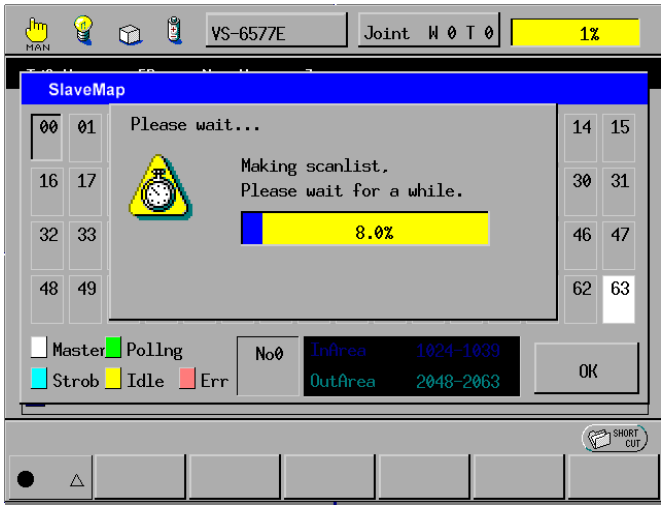
The latest scanlist will appear.
Press [F4 Scanning] on this screen.
(The default of the slave map is the fixed I/O allocation screen.)



F4

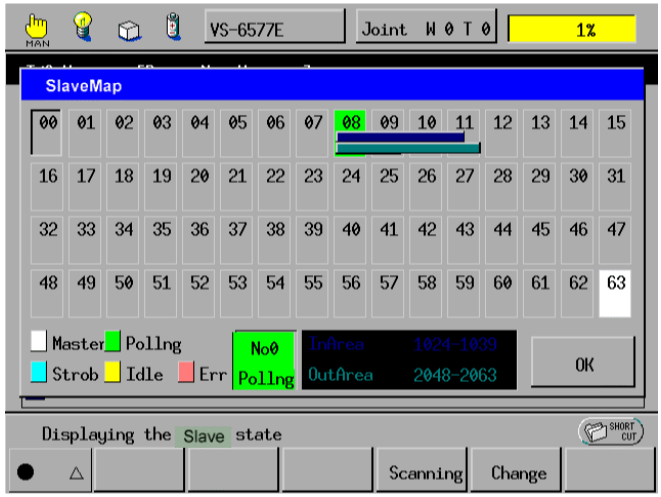
Step 5

Wait for a while when the network is being scanned.



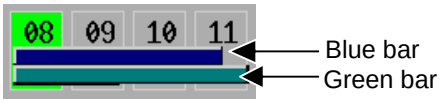
Step 6

The current scanning results will display.



Screen explanation

In the fixed I/O allocation, each block has 16 input points and 16 output points. The whole screen area represents 16 × 24 = 1024 I/O points.



In the figure shown at left, the blue bar indicates the number of input points at node 8 and the green bar, the number of output points.

This slave has the following numbers of points:

Inputs = 3.5 blocks × 16 = 56 points
Outputs = 4.0 blocks × 16 = 64 points

Since the number of I/O points increases in 8-point increments, the bar indications increase or decrease in 0.5-block units.

The left display shows the I/O number of the selected node.

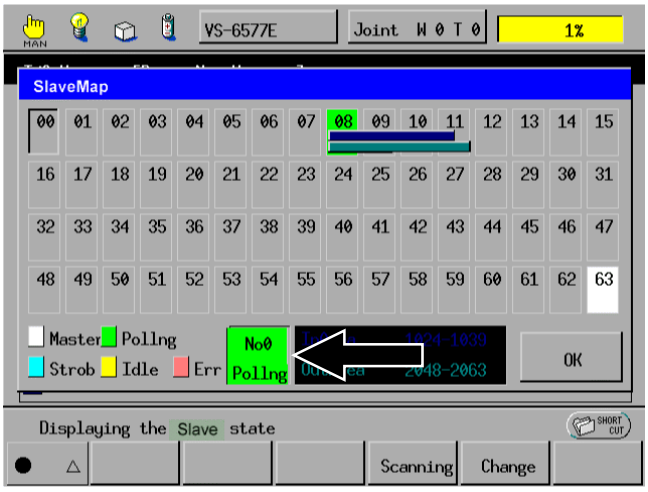
By default, the information for node 0 is displayed.

To change the node, press the node number whose information you want to display.

Displaying and changing node (slave) setting information

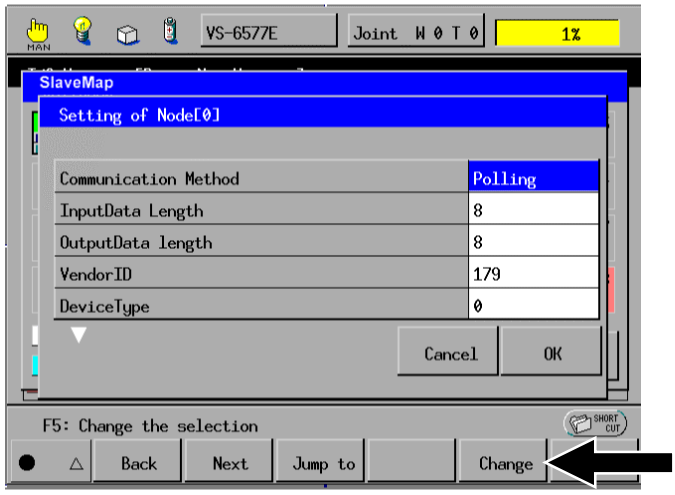
Step 1

To display or change node information, press the relevant node number on the screen below.



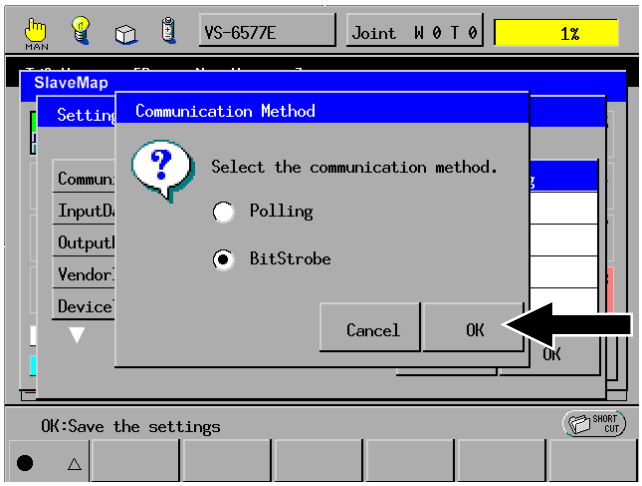
Step 2

On the screen below, only the communication method and I/O data length can be changed: the other parameters are displayed but cannot be changed.



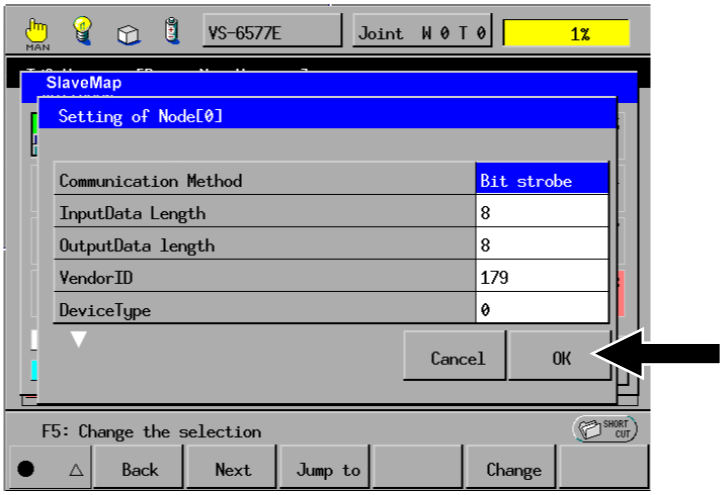
Step 3

As an example, let's change node 0 to the bit strobe mode here. Note that when the communication method is changed, an error will occur if the specified slave lacks the chosen communication function.

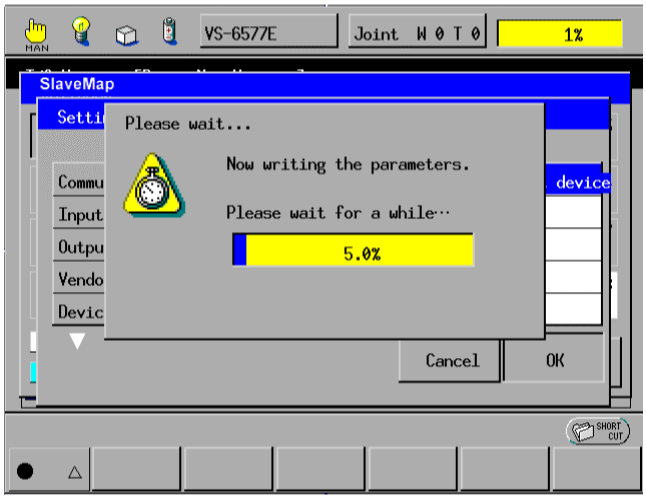


Step 4

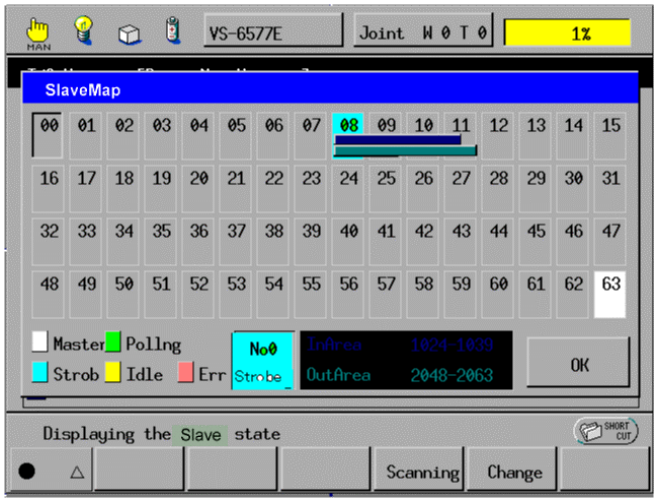
If the displayed communication method is OK, press [OK].



Step 5 The DeviceNet master changes the interface with the slave.



Step 6 Node 0 has been changed to the bit strobe mode.



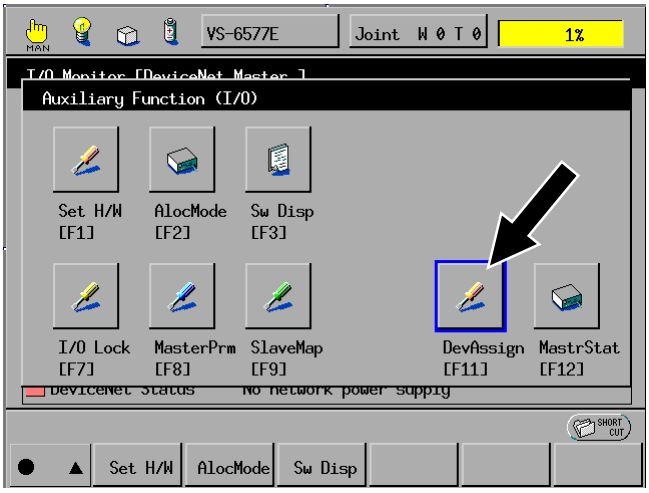
NOTE: You may change the I/O data length also on this screen but you need to make the same setting change for slaves at the same time, which makes the setting difficult. If you change the slave parameters, therefore, you are recommended to scan the network again.

Changing the I/O allocation mode

The procedure for switching from the fixed I/O allocation mode to the free I/O allocation mode is explained here.

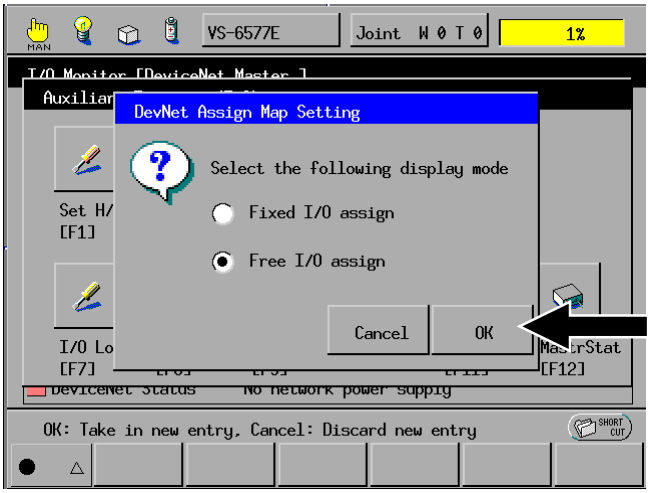
Step 1

Press [F11 DevAssign] on the Auxiliary Function (I/O) screen.



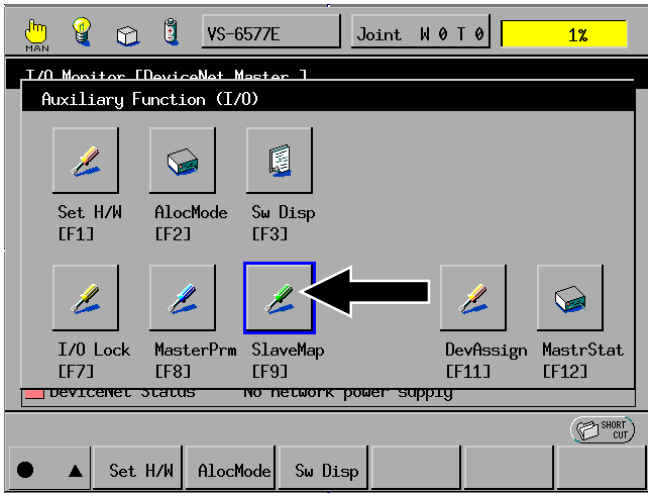
Step 2

Change the setting from “Fixed I/O assign” to “Free I/O assign” and press [OK].

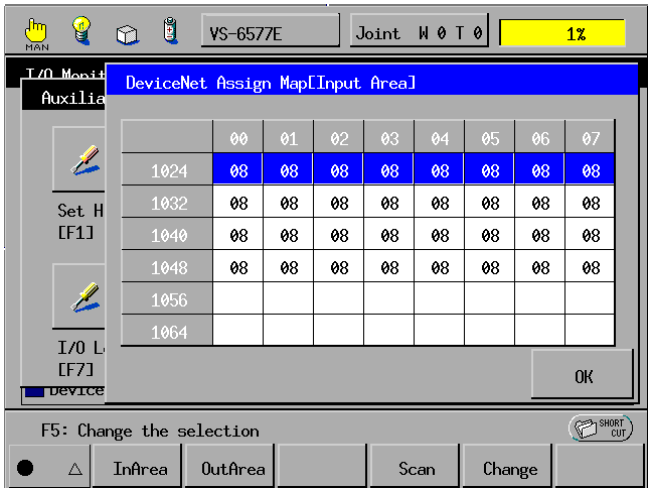


Step 3 In accordance with the change of the allocation mode, the DeviceNet master scans the network and changes the I/O allocation.

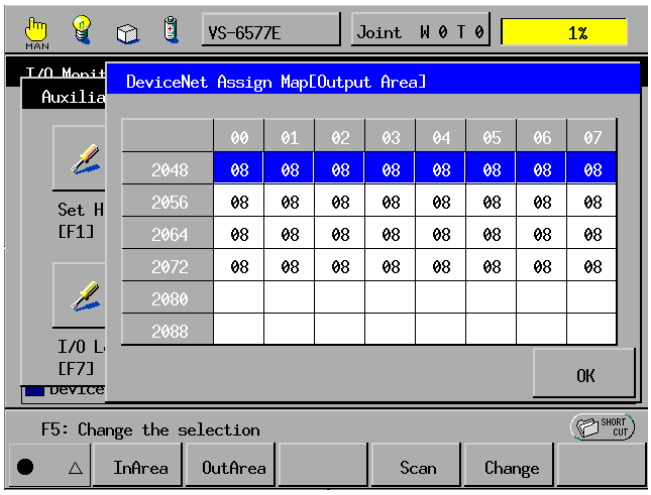
Step 4 When the following screen appears, the scan is completed. Press [F9 SlaveMap] and confirm the new setting.



Step 5 The input area in the free I/O allocation mode will display.

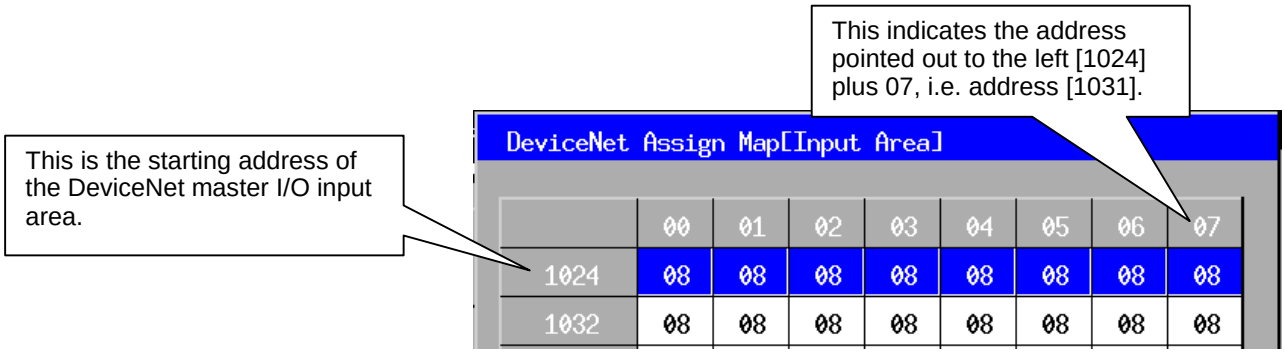


Step 6 Press [F2 OutArea] to display the output area.



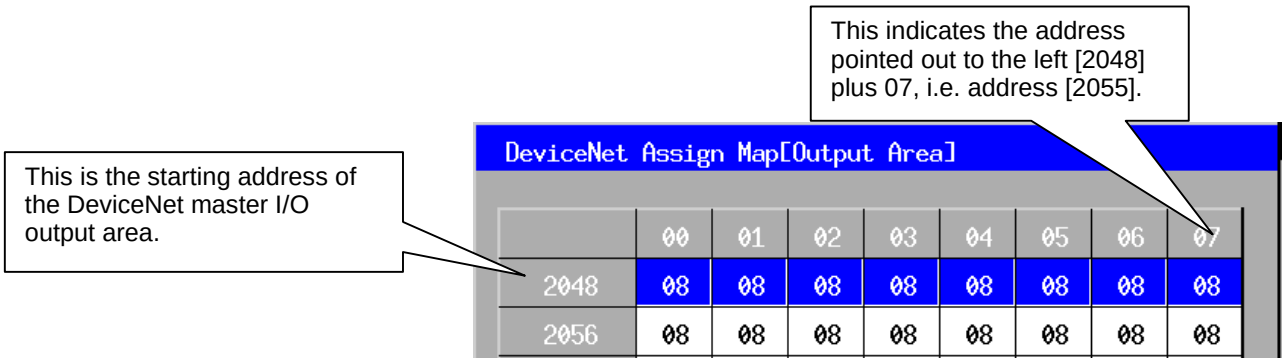
Explanation about screen

Input area display screen


This indicates the address pointed out to the left [1024] plus 07, i.e. address [1031].
This is the starting address of the DeviceNet master I/O input area.
DeviceNet Assign Map[Input Area]
00 01 02 03 04 05 06 07
1024 08 08 08 08 08 08 08 08
1032 08 08 08 08 08 08 08 08

The display above indicates that slave ID4 is allocated to input areas 1024 to 1039.

Output area display screen


This indicates the address pointed out to the left [2048] plus 07, i.e. address [2055].
This is the starting address of the DeviceNet master I/O output area.
DeviceNet Assign Map[Output Area]
00 01 02 03 04 05 06 07
2048 08 08 08 08 08 08 08 08
2056 08 08 08 08 08 08 08 08

The display above indicates that the following allocations have been made:

Output areas 2048 to 2055: Output to slave ID0
Output areas 2056 to 2063: Output to slave ID3
Output areas 2064 to 2071: Output to slave ID4

[Scan] and [Change] keys

The functions of these keys are equivalent to the fixed allocation mode.

[Scan] recreates the scanlist.

[Change] changes the slave settings.

9.4.3 Changing Master Parameters

Usually there is no need to change these parameters. This is because the DeviceNet master automatically detects the network status and writes the typical parameters.

Only when you need to change the EPR or ISD, change these parameters. For example, you need to decrease the EPR value in order to shorten the disconnection detection time.

To make master parameters revert to the original after change, enter “0.”

Do not change serial numbers.

What is “EPR” (Expected Packet Rate)?

This value is the basis for judging a “timeout” when the slaves communicate with the master (polling or bit strobe). If there is no access from the master during the set time, then the slave times out and an error status is established. For the master, this value is the setting for the disconnection detection time.

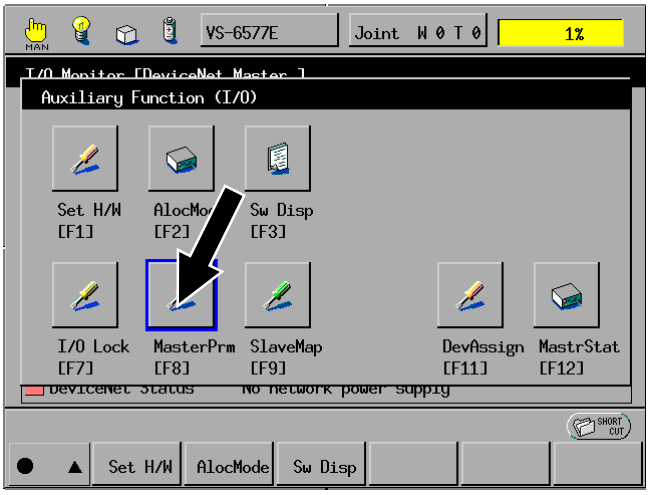
The relationship is: Detection time = EPR value × 4 (ms)

Note that if a too small value is entered, the “No response from slave” error will occur even in normal status.

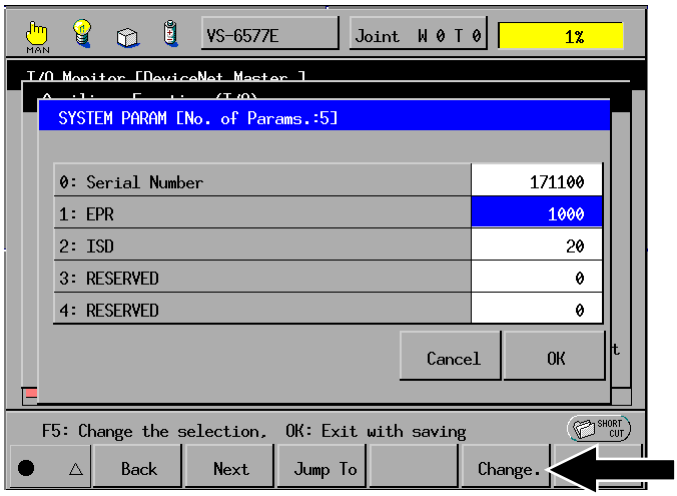
What is “ISD” (Inter Scan Delay)?

This is the interval between the scan cycles in which the master scans the slave devices.

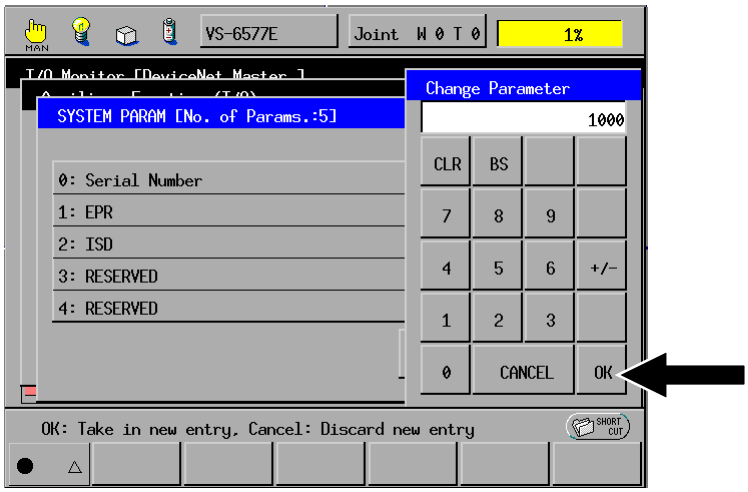
Step 1 On the Auxiliary Function (I/O) screen, press [F8 MasterPrm].



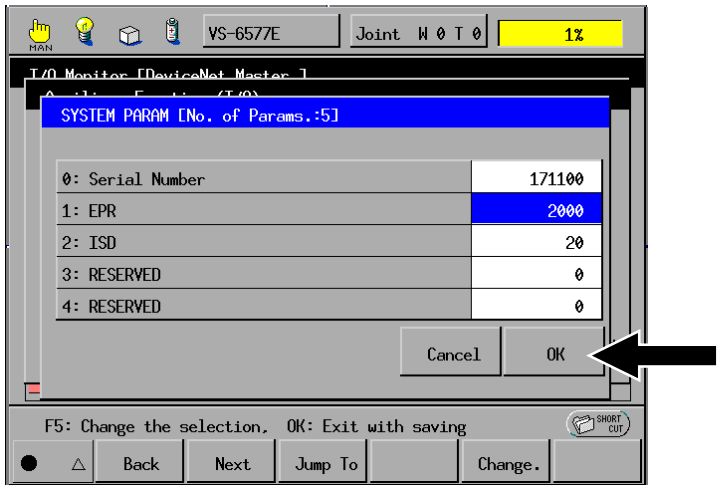
Step 2 As an example, assume that the EPR should be changed.



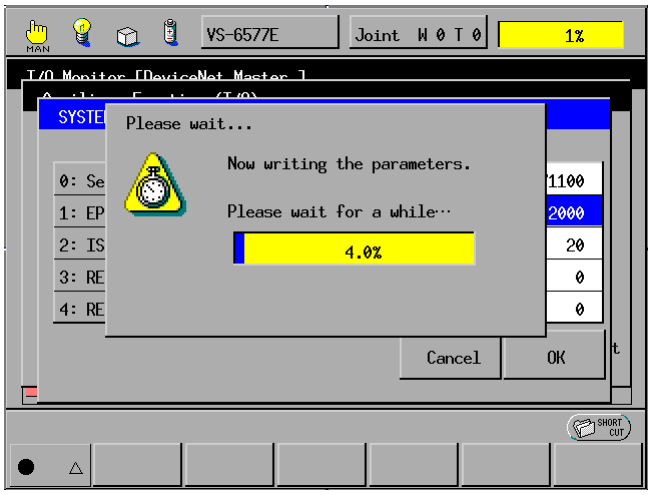
Step 3 On the SYSTEM PARAM screen, enter a new value and press [OK].



Step 4 In this example, enter “2000” here. Check the entered value. If it is normal, press [OK].

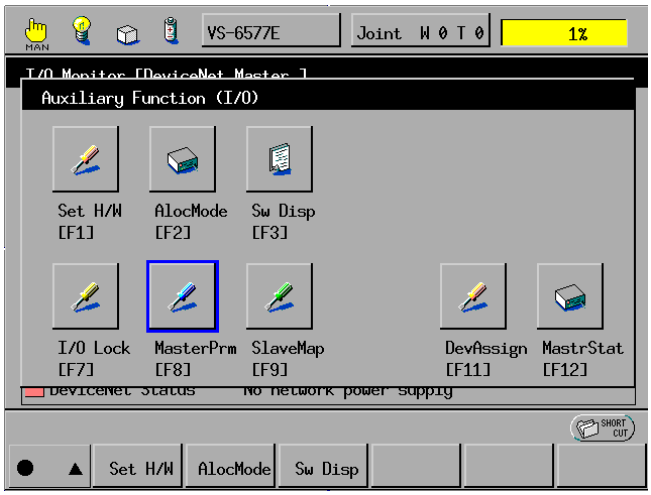


Step 5 The data will be written to the memory of the DeviceNet master.



Step 6 Based on the new values, the network is being constructed.

Step 7 After parameter writing is normally completed, the following screen will display.



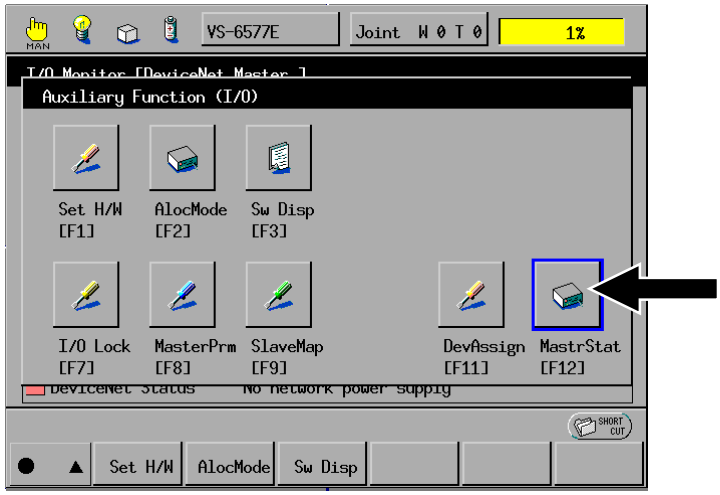
NOTE: You may change the ISC value in the same procedure.

9.4.4 Displaying the Master Status

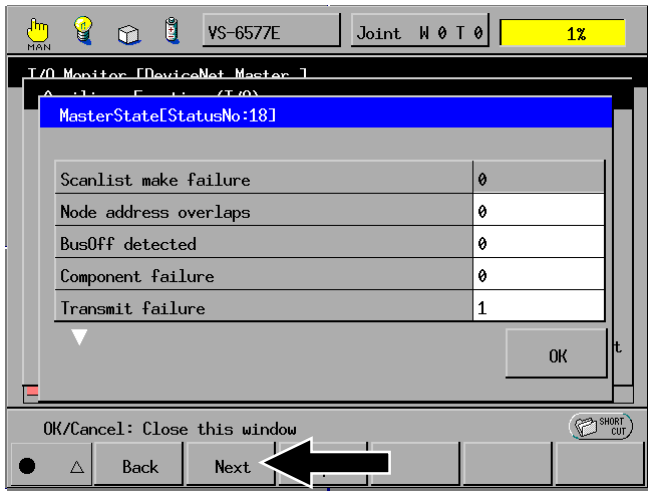
The MasterState screen allows you to check the current communication status of the DeviceNet master and the flag statuses.

It is intended for reference, for example when a network error has occurred.

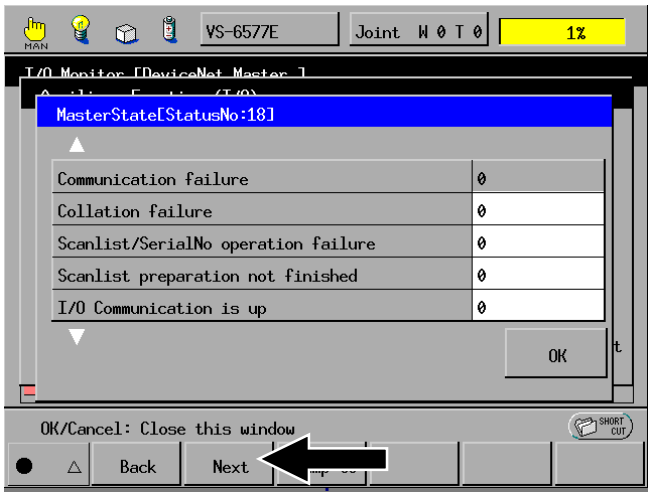
Step 1 Press [F12 MastrStat].



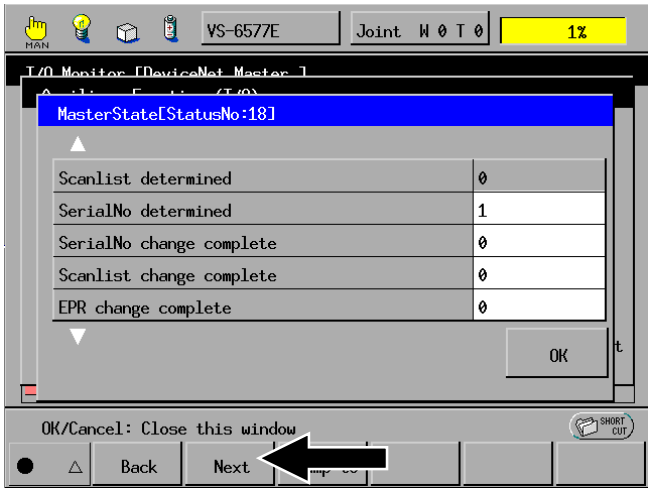
Step 2 Out of the 18 statuses, the heading five will display.



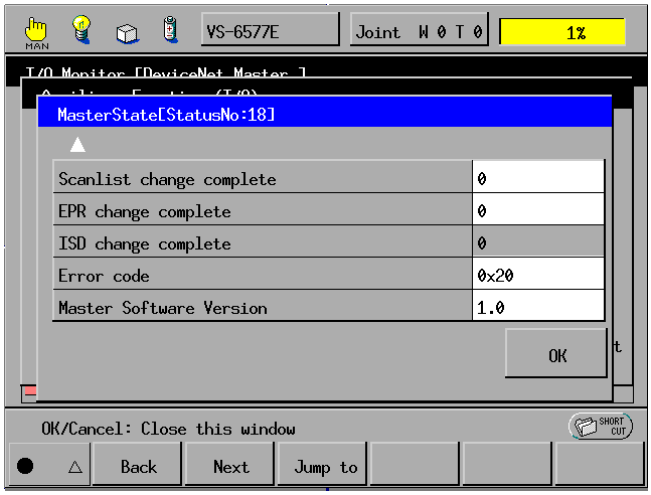
Step 3 The next statuses will display.



Step 4 The following statuses will display.



Step 5 The last statuses will display.



Details of errors and the meanings of flags are given below.

Error No.	Error Details	
0x01	Configuration error	I/O area duplicated
0x02		Out of I/O area
0x03		Unsupported slave detected
0x04	Collation error	No registered slave
0x05		Slave I/O size mismatch
0x06	Communication error (communication timeout)	
0x10	Node address double-assigned	
0x11	Busoff detected	
0x20	Transmission error	Network power supply error
0x21		Transmission timeout
0x30	Memory error	RAM error
0x31		ROM error
0x32		DPRAM error
0x33		DPRAM retry error
0x34	Flash ROM error	Serial number error
0x35		EPR error
0x36		ISD error
0x37		Scanlist error
0x41	Robot setting bit error	

Scanlist make failure:

Shows that an error has occurred during creation of a scanlist.

Scanlist/SerialNo operation failure:

Shows that there is an error in the scanlist/serial number data.

Scanlist preparation not finished:

Shows that the scanlist is still being created.

I/O Communication is up:

Shows that the master is normally communicating with the slaves.

Scanlist already set up:

Shows that a scanlist already exists in the memory of the master.

Serial No determined:

Shows that a serial number already exists in the memory of the master.

SerialNo change complete:

This is a flag used by the system in serial number overwriting. Normally, 0 is written here.

Scanlist change complete:

This is a flag used by the system in scanlist overwriting. Normally, 0 is written here.

EPR change complete:

This is a flag used by the system in EPR overwriting. Normally, 0 is written here.

ISD change complete:

This is a flag used by the system in ISD overwriting. Normally, 0 is written here.

Master Software Version:

Shows the version of the software running on the master board.

9.4.5 Network Error Indication on DeviceNet Master

The network error display parameter is set to "0: Every Time" by default. It means that a network error will display every time if it occurs at execution of each I/O command.

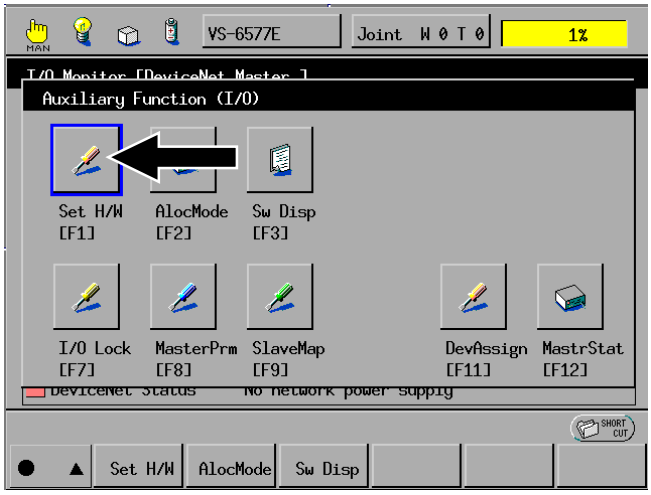
The default is for safe operation of the facilities and is ideal for practical operation. However, during checking of program operations with dummy I/Os for adjusting facilities, you need to set this parameter to "1: First Time." Doing so will not display errors once detected, allowing you to check program operations.

NOTE: After completion of adjustment, be sure to set this parameter back to "0."

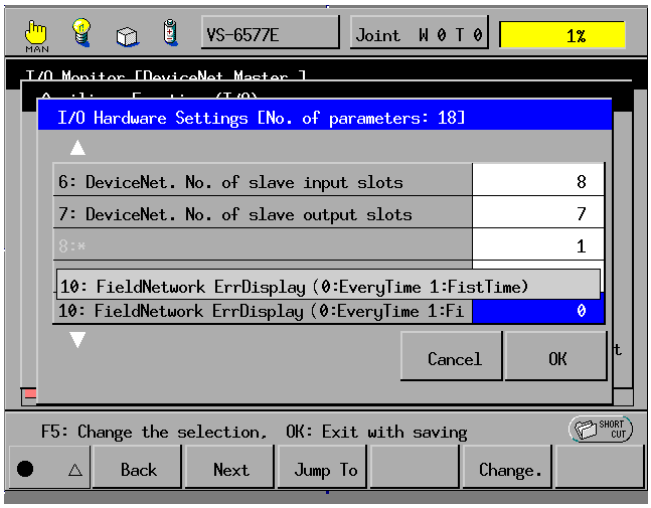
Changing the FieldNetwork ErrDisplay parameter

Access: [F4: I/O]—[F6 Aux.]—[F1 Set H/W]

Step 1 In the Auxiliary Function (I/O) window, press [F1 Set H/W].

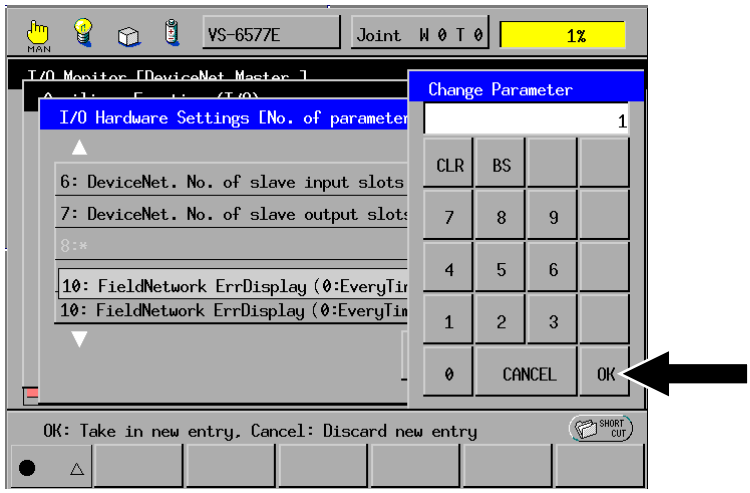


Step 2 Select "10: FieldNetwork ErrDisplay" and press [F5 Change].

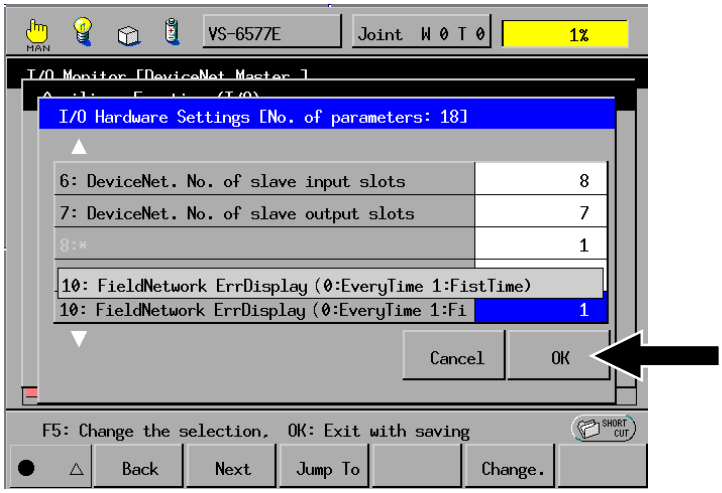


F5

Step 3 Enter “1” in this example and press [OK].



Step 4 Check the newly entered value and press [OK].

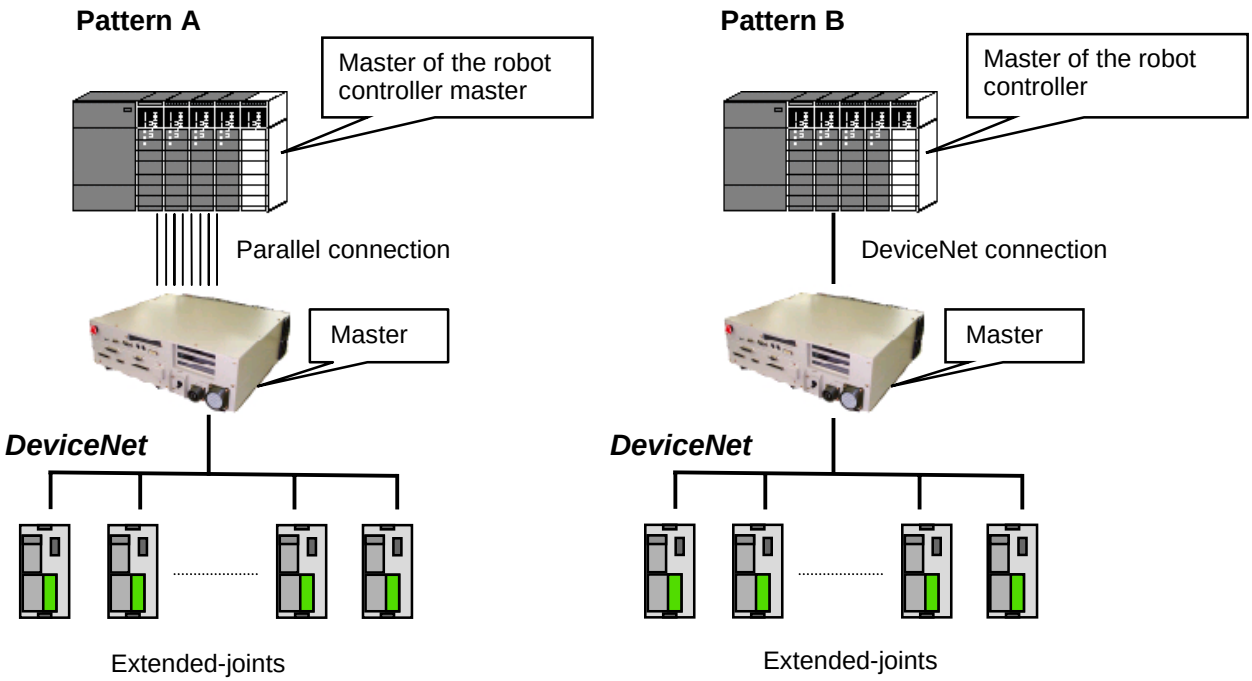


Step 5 Following this system message, switch the controller power OFF and then ON.

NOTE: If this message appears, you must switch the controller power OFF.

9.4.6 Allocating Ports Dedicated to the DeviceNet Master

In the DeviceNet master allocation mode, parallel and DeviceNet master I/O areas are basically allocated to user ports, except that I/O numbers 72 (Normal robot CPU), 73 (robot-in-operation), and 74 (robot failure) are allocated to system output ports.



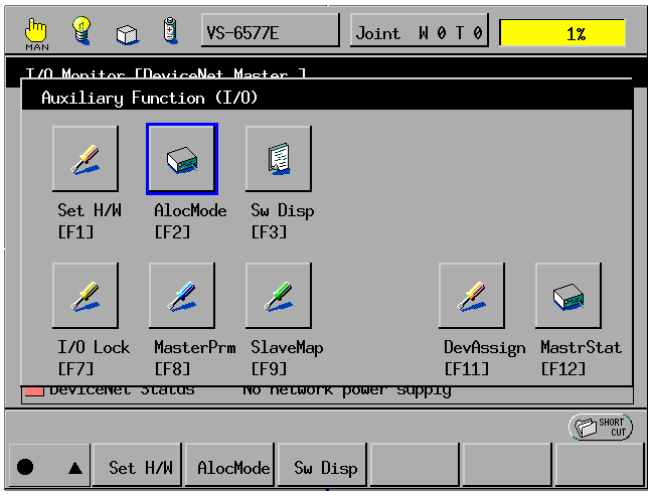
The robot controller can be configured to the DeviceNet networks as shown above. To configure the robot controller to any of those networks, you need to change the I/O allocation according to the procedure given on the following pages.

Changing allocation of ports dedicated to the DeviceNet master

Step 1

On the top screen of the teach pendant, press [F4 I/O] and then press [F6 Aux.].

The following screen will appear. Press [F2 AlocMode].

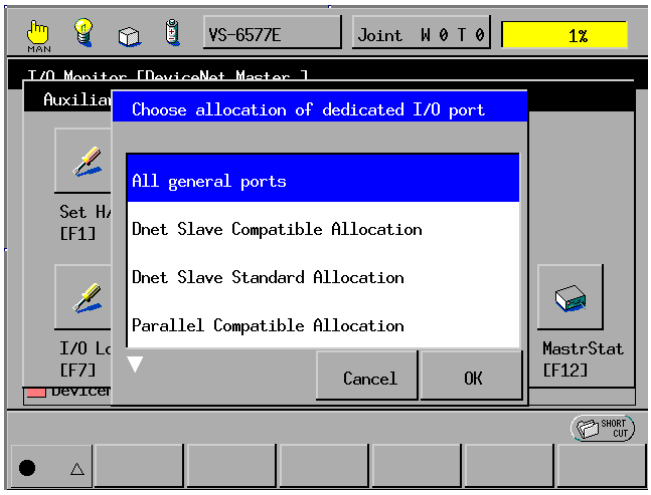


F2

Step 2

Using the jog dial or the cursor keys, select the desired allocation mode. Next, press [OK].

To cancel the changes made, press [Cancel].



Step 3 Following the system message, switch the controller power OFF and then ON.

NOTE: If this message appears, you must switch the controller power OFF.

Chapter10 PROFIBUS-DP Slave Board

10.1 Overview

If the robot controller has a PROFIBUS-DP slave board built-in, it may communicate with external devices according to the PROFIBUS-DP–compliant communications protocol. The robot controller works as a slave unit.

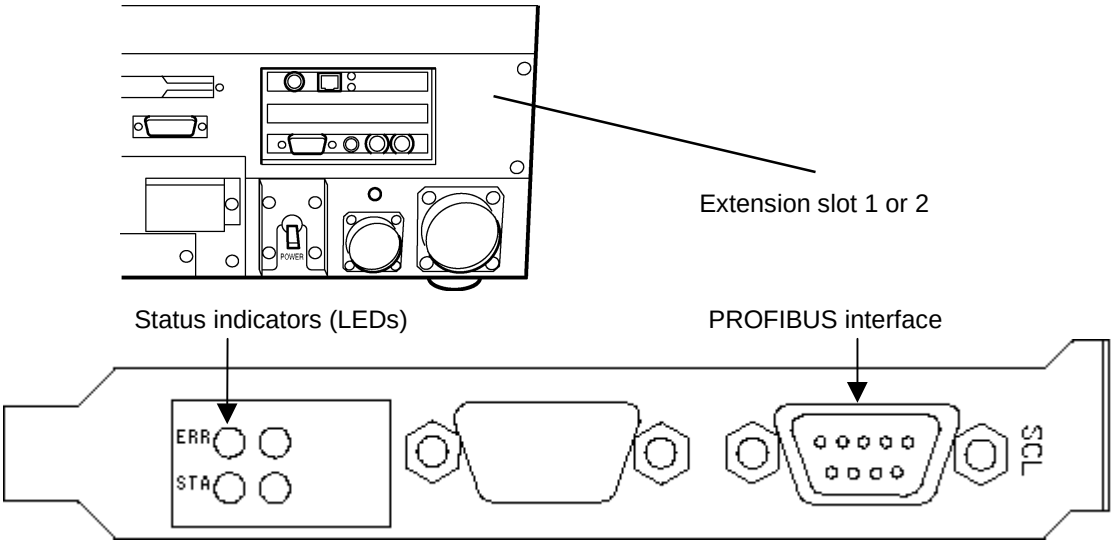
The robot controller may exchange I/O data with PROFIBUS-DP–compliant field devices of different manufacturers.

For details about PROFIBUS, refer to the PROFIBUS website as shown below.

PROFIBUS International http://www.profibus.com

10.1.1 Location of the PROFIBUS-DP Slave Board and Functions of its Components

The PROFIBUS-DP slave board may be inserted into extension slot 1 or 2 of the robot controller.



Name	Explanation	
Status indicators (LEDs)	ERR	Lights in red when an error occurs in the PROFIBUS-DP slave board.
	STA	Lights in yellow when the communications link is established.
PROFIBUS interface	RS485 connector (9-pin D-SUB female)	

For the function of each board component, refer to the instruction manual that comes with the PROFIBUS-DP slave board.

NOTE: Do not change the jumper settings made on the slave board. If you do so, the board will not function.

NOTE: The robot controller does not use the diagnostic interface, RDY LED, or RUN LED mounted on the slave board.

10.1.2 Installing the Robot Controller Equipped with a PROFIBUS-DP Slave Board

[Refer to the "Installing the Robot Controller" given in the INSTALLATION & MAINTENANCE GUIDE.]

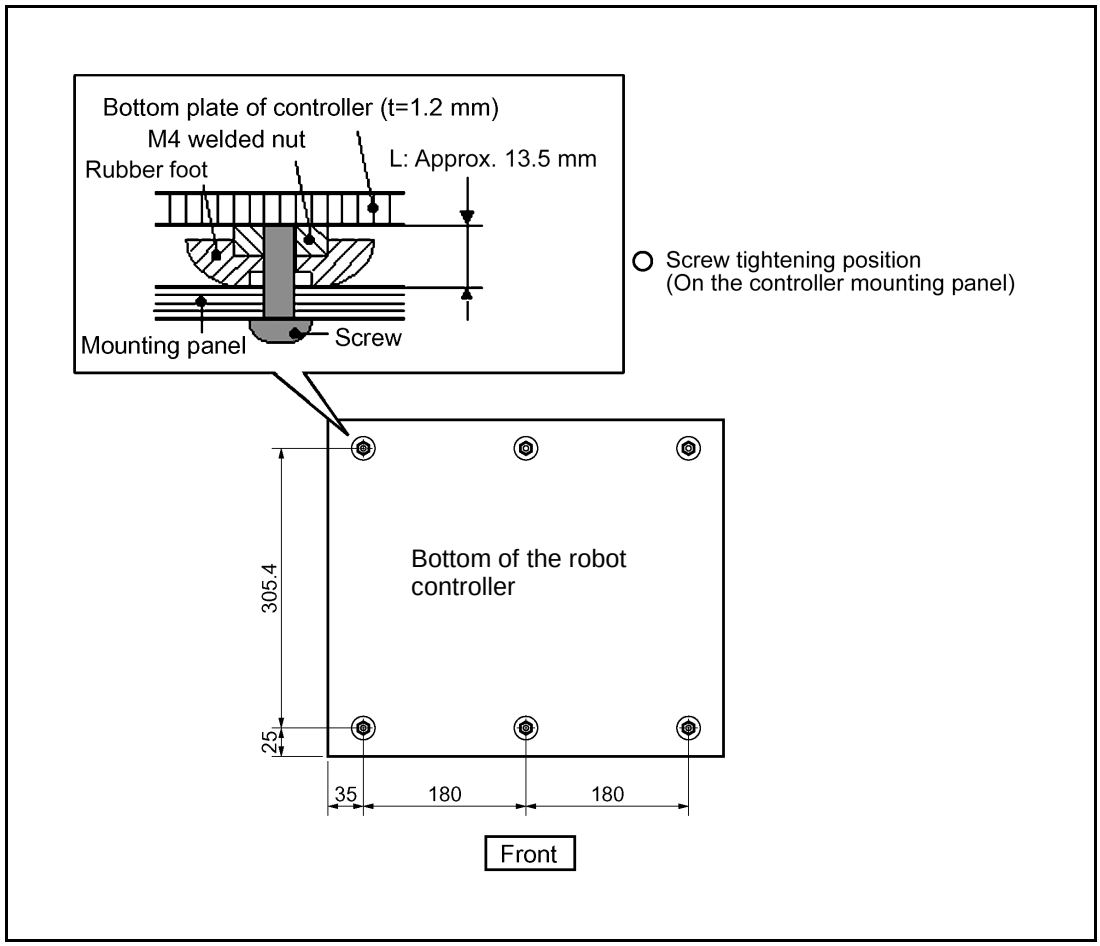
When locating the robot controller equipped with a PROFIBUS-DP slave board onto a place where the controller may be subjected to vibration, install it "stand-alone" or "to the mounting panel with controller's rubber feet kept attached (see below)."

Securing the Robot Controller to the Controller Mounting Panel

(1) The figure below shows the bottom view of the robot controller. Marked with "O," the M4-nut welded holes may be used for securing the robot controller to the mounting panel.

(2) Prepare a mounting panel large enough to mount the robot controller. While keeping the rubber feet attached to the robot controller, secure the controller to the mounting panel at six nut-welded holes marked with "O" shown in the figure below, using six M4 screws.

⚠Caution (1) The controller mounting screws must not be more than the thickness of the mounting panel plus 13.5 mm in length. If they exceed 13.5 mm, the nut welded holes may be damaged.
(2) Fix the robot controller at all of the six nut-welded holes.



Securing the Controller to the Mounting Panel, keeping the Rubber Feet Attached

10.1.3 Specifications

Item	Specifications					
Communications protocol	PROFIBUS-DP–complient					
Transmission speed	9.6K, 19.2K, 93.75K, 187.5K, 500K, 1.5M, 3M, 6M, and 12M bps, with automatic recognition					
Interface connector	9-pin, D-sub connector					
Communications media	RS-485 interface cable (Type A recommended)					
Communications distance (when Type A interface cable is used)	Transmission speed (bps)	9.6 K to 93.75 K	187.5 K	500 K	1.5 M	3 M to 12 M
	Distance/segment	1200 m	1000 m	400 m	200 m	100 m
PROFIBUS address	1 to 125					
Max. number of stations	126 (when the repeater is used)					
Number of I/Os	Standard assignment: 40 points for system input 32 points for system output 24 (default) to 216 points for user input 32 (default) to 224 points for user output Compatible assignment: 24 points for system input 32 points for system output 40 (default) to 232 points for user input 32 (default) to 224 points for user output					
Board model	CIF30-DPS					

10.2 Assignment of Serial I/O Data

Two types of serial I/O data assignment modes are available--standard assignment mode and compatible assignment mode.

The I/O data assignment is the same as that for the DeviceNet slave board. For the assignment, refer to Chapter 8, “DeviceNet Slave Board.”

The robot controller equipped with a PROFIBUS-DP slave board transfers system I/O data only through the PROFIBUS-DP slave board, disabling the parallel ports. The controller, however, can handle user I/O data using both the PROFIBUS-DP slave board and parallel ports.

Signals such as Robot stop, Enable auto, and CPU normal will be transferred only through the parallel ports.

10.3 Parameter Entry Procedure

10.3.1 Entering the Node Address and Number of I/Os with the Teach Pendant

You may choose the number of I/Os for the robot controller from the tables given below. These I/Os are viewed from the robot controller. They are opposite of the I/Os displayed on the teach pendant, as listed below.

Points for User Input

Points for input	Max. number of points in standard assignment mode	Max. number of points in compatible assignment mode	Display on the teach pendant
64 points (8 bytes)	24 points (3 bytes)	40 points (5 bytes)	8byte Output con
96 points (12 bytes)	56 points (7 bytes)	72 points (9 bytes)	12byte Output con
128 points (16 bytes)	88 points (11 bytes)	104 points (13 bytes)	16byte Output con
160 points (20 bytes)	120 points (15 bytes)	136 points (17 bytes)	20byte Output con
256 points (32 bytes)	216 points (27 bytes)	232 points (29 bytes)	32byte Output con

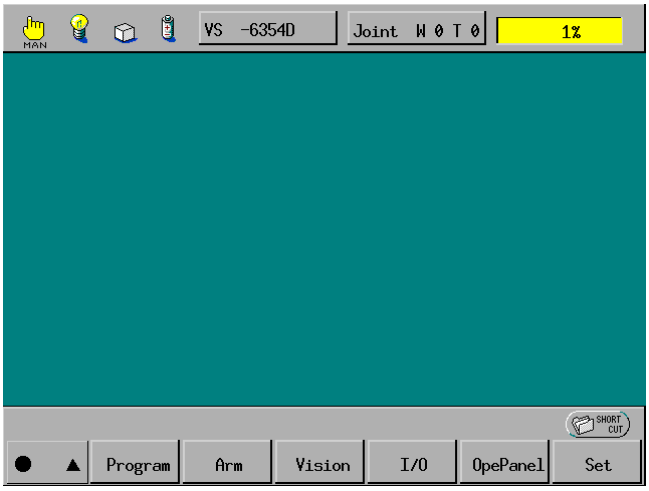
Points for User Output

Points for output	Max. number of points in standard or compatible assignment mode	Display on the teach pendant
64 points (8 bytes)	32 points (4 bytes)	8byte Input con
96 points (12 bytes)	64 points (8 bytes)	12byte Input con
128 points (16 bytes)	96 points (12 bytes)	16byte Input con
160 points (20 bytes)	128 points (16 bytes)	20byte Input con
256 points (32 bytes)	224 points (28 bytes)	32byte Input con

Operating Procedure for Setting Node Address and I/O Module

Step 1

On the top screen of the teach pendant, press [F4 I/O.]-[F6 Aux.]-[F6 PROFI slv].



The PROFIBUS-DP Slave window will appear as shown below.

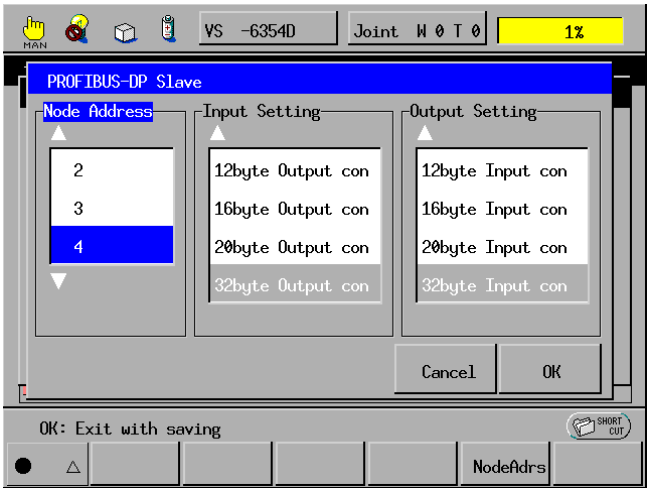
Step 2

Choose the Note Address, Input Setting, or Output Setting field that you want to set by using the right- and left-arrow cursor keys or directly touching the target item field.

Make the desired setting for each item by using the up- and down-arrow cursor keys or directly touching the target setting field.

Pressing [F5: NodeAdrs] will show the numeric keypad where you may enter the desired numeral.

After completion of setting, press [OK]. If you press [Cancel], the newly entered values will be discarded.



F5

Step 3

On the screen shown in Step 2, press [OK]. The system message window will appear as shown below.

Turn the controller power off and on. Then the new settings will take effect.

10.3.2 Configuring the Robot Controller from the PC with the PROFIBUS Configurator

Configure the robot controller (node address and I/O module) by using the PROFIBUS configurator (GSD file) stored in the CD-ROM that comes with the PROFIBUS slave board.

CD-ROM:\EDS\PROFIBUS\GSD\Hil_7504.gsd

You may also download the GSD file from the PROFIBUS website as shown below.

http://www.profibus.com

GSD Library → Company “Hilscher” → Device Type “General”
→ CIF30-DPS → Hil_7504.GSD

I/Os expressed in the PROFIBUS configurator are viewed from the master device. Therefore, they are opposite of those viewed from the robot controller and are the same as viewed from the teach pendant, as listed in Subsection 10.3.1.

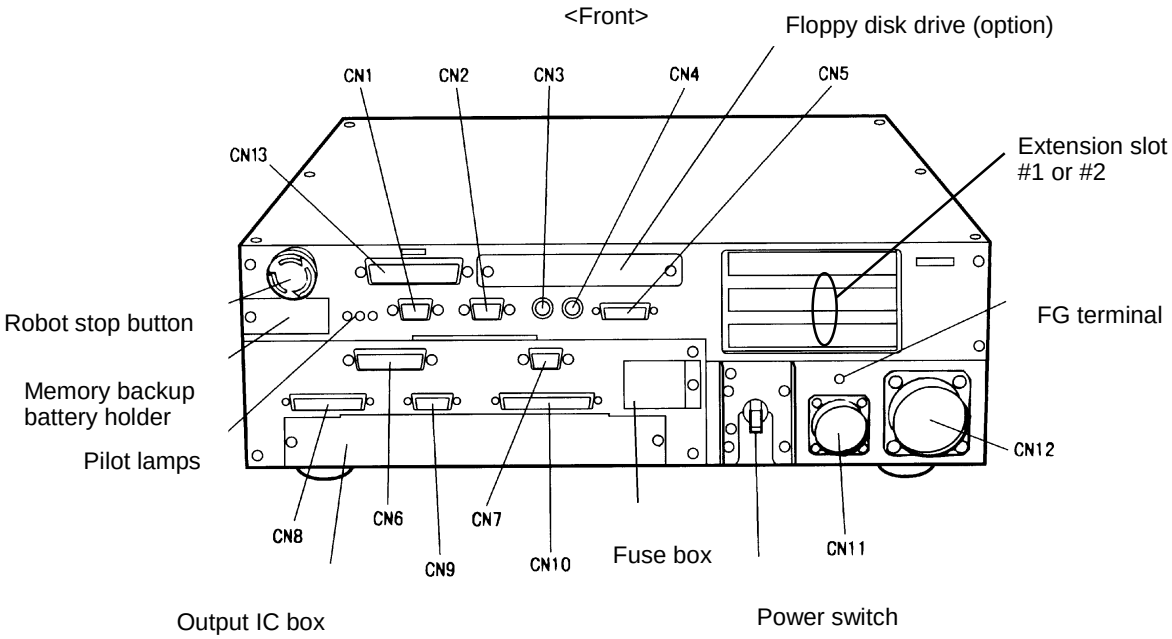
When configuring the robot controller on the PC with the PROFIBUS configurator, set the same module as one selected on the teach pendant screen. Slot 0 and Slot 1 should be equal to "n byte Output con" and "n byte Input con," respectively.

NOTE: The robot controller may use a coherent type of module only. The GSD file contains both programs for coherent and incoherent types, so be sure to choose the program exclusive to the coherent type. (The program name contains a "con" string.)

NOTE: Some master device programs use special functions when exchanging data with a coherent type of module. For details, refer to the instructions manuals prepared for master devices.

Chapter11 Configuring the RS-232C Extension Board (Recommended Option)

If you install an RS-232C extension board to the robot controller, the controller may support three RS232C serial data transmission lines (One standard line plus two add-on lines). The RS-232C should be set into extension slot #1 or #2.



11.1 Recommended RS-232C Extension Board

Set up an RS-232C extension board specified below in your charge.

Model	COM-2(PC)F
Manufactured by	CONTEC

NOTE: To support an RS-232C extension board, the robot controller requires some special features to be built in at the factory. When placing an order for the robot controller, specify the RS-232C extension board support.

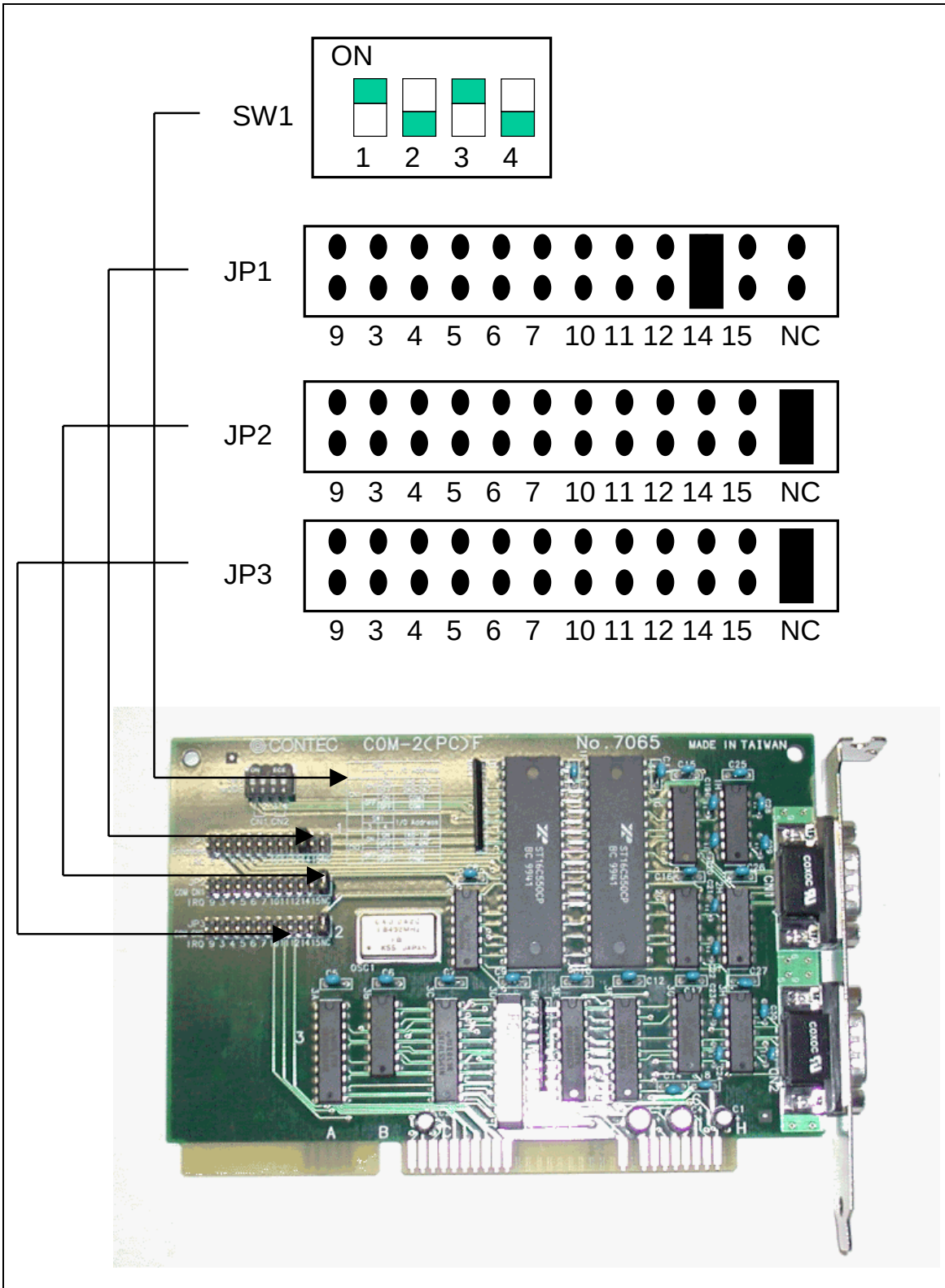
11.2 Installing the Extension Board

For the installation procedure, refer to Chapter 12, "Mounting Extension Boards."

11.3 Setting the Jumpers and DIP Switch on the RS-232C Extension Board

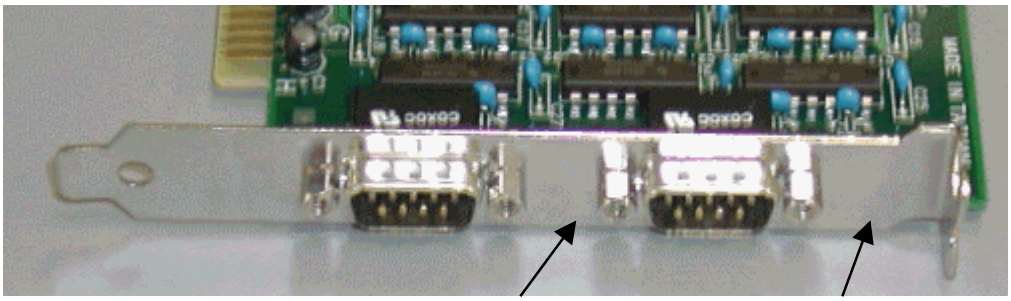
Set the jumpers and DIP switch on the RS-232C extension board as shown below.

Jumper/DIP SW	SW1	JP1	JP2	JP3
Settings	Set selectors 1 and 3 to ON.	Set a jumper cap onto pin 14.	Set a jumper cap onto NC.	Seta a jumper cap onto NC.



11.4 RS-232C Extended Serial Ports and Line Number Assignment

The RS-232C extension board features two COM ports--COM3 and COM4. Two serial data transmission lines #2 and #3 are assigned to COM3 and COM4, respectively.



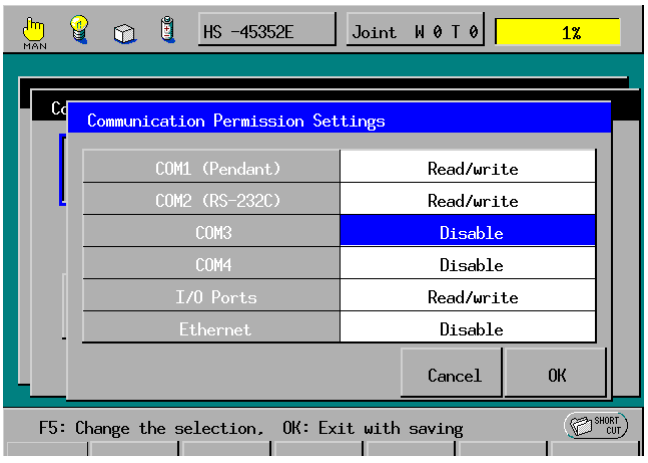
COM4 (#3)　　COM3 (#2)

11.5 Communications Configuration of RS-232C Extension Board

Follow the procedure described below to configure communications feature of COM3 and COM4 on the RS-232C extension board.

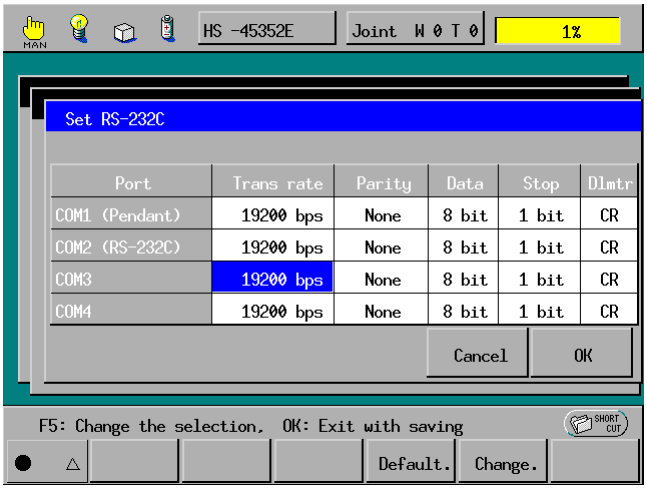
■ Setting the communication permission
Access: [F6: Set]—[F5: Set Com.]—[F1 Permit.]

CAUTION: COM3 and COM4 do not support data transmission with WINCAPSII. Keep both of those ports "Disable" (Default).



■ Setting the transmission rate for RS-232C serial interface ports
Access: [F6: Set]—[F5: Set Com.]—[F2 Serial IF]

Select each of the COM3 and COM4 and then press [F5 Change.] to the transmission rate, parity (None, Odd or Even) and other values.



NOTE: The default transmission speed for the RS-232C extension board is 19,200 bps. The maximum transmission speed is 38,400 bps.

If the transmission speed is set to 38,400 bps, however, a communications failure may occur frequently. Even at 19,200 bps, a communications failure may also occur due to electric noises or other interference.

In programming, therefore, you may need to use the `com_state` command for setting retry capabilities as shown in the coding sample below.

11.6 Coding Sample for Transmission Error Recovery

```
'!TITLE "<Title>"
PROGRAM sample
            .
            .
            .
            DEFPOS lp1(10)        'Local position variable.
            DEFINT li1            'Local integer variable.
            ,
            .
            .
            li1 = 0               'Initialize li1.
            .
            .
            .
            WHILE li1 < 10        'Repeat pre-decision.
            .
            .
            .
            INPUT #2,lp1(li1)     'Get data on line #2 into
                                  'li1(li1).
            com_state #2,I280     'Get communication status into I280.
            IF I280 < 0 THEN      'If an error occurs, the value is –1.
            PRINT #2,"R"          'Output retry instruction.
            ELSE
            PRINT #2,"A"          'Output "normal receive".
            li1 = li1 + 1
            END IF
            .
            .
            .
            .
            WEND                  'Repeat 10 times.
            End
```

In the coding sample above,

It is assumed that "R" is a retry command that requires the external equipment to make retry operation and "A" is an acknowledge command for normal data reception.

11.7 Limited Warranty

DENSO WAVE provides the user with the communications function built in the controller for using the RS-232C extension board. It does not give you any warranty or technical support for the extension board itself.

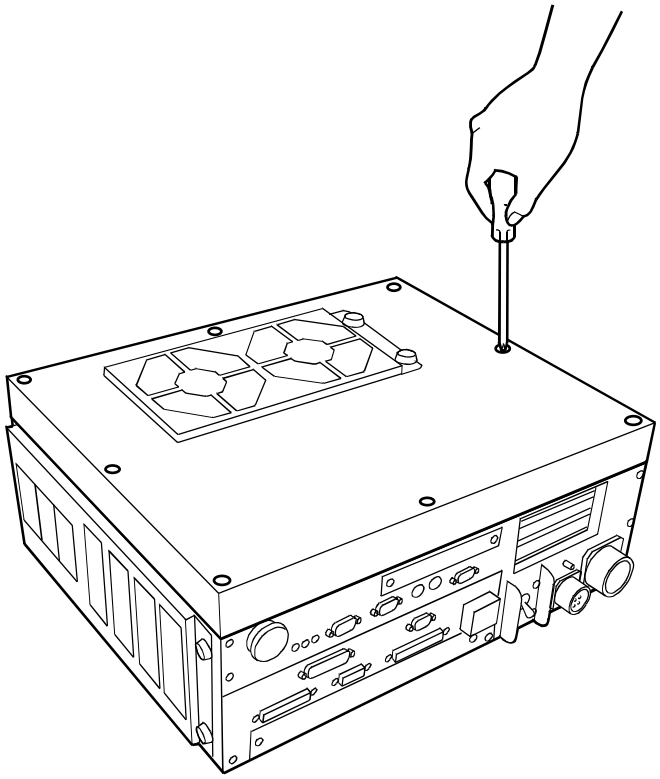
Chapter12 Mounting Extension Boards

This section describes how to mount the μVision board, Ethernet board, and DeviceNet boards.

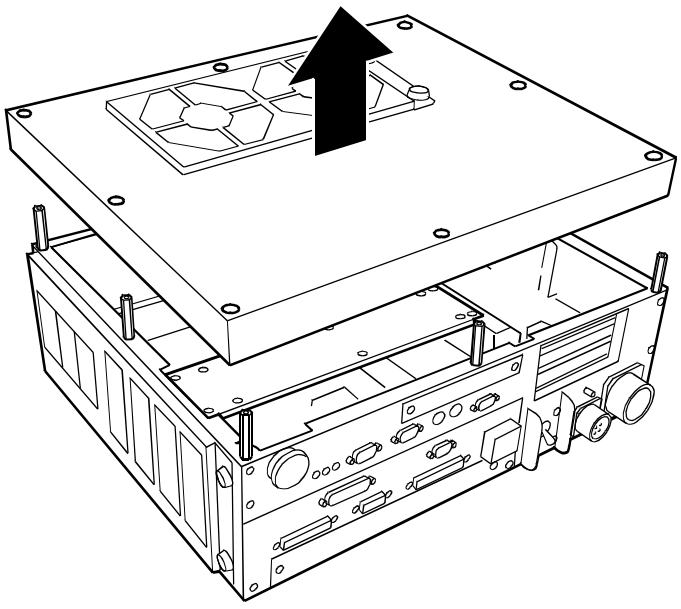
If you do not mount all of these boards, skip steps unrelated to the object board.

NOTE: In the illustrations below, the typical controller model is drawn.

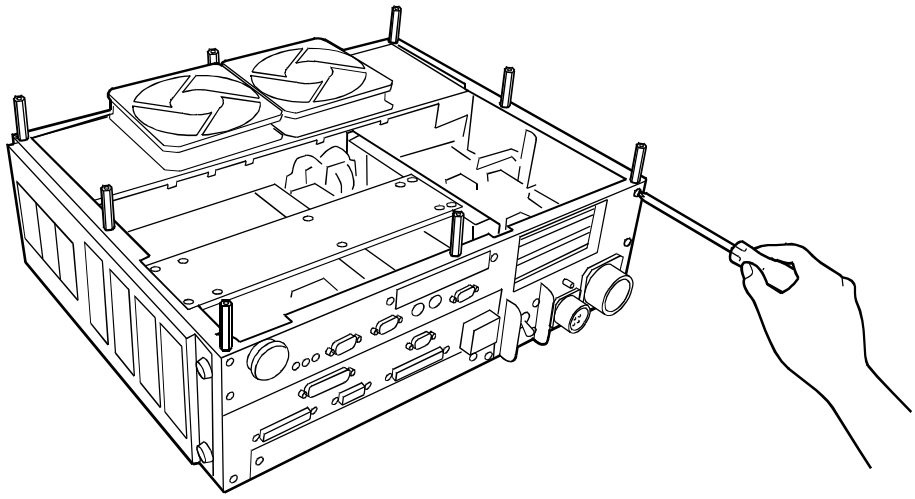
Step 1 Remove the eight screws from the controller top cover.



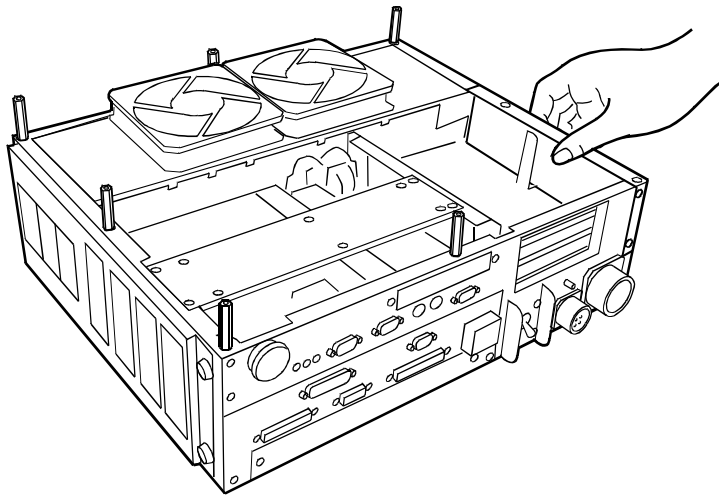
Step 2 Lift and remove the top cover from the robot controller.



Step 3 Remove the two screws fastening the side plate from the front panel of the robot controller as shown below.



Step 4 Remove the side plate.

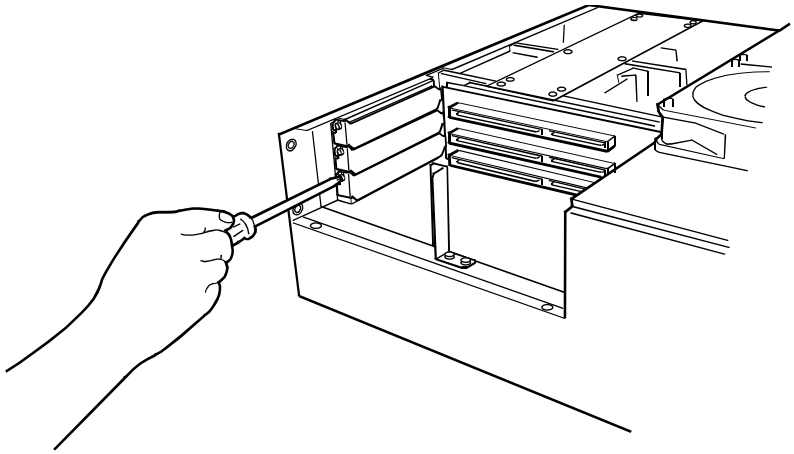


Step 5

Remove the panel fastening screw and then the panel hole blank cap.

To mount the μVision board, remove the lower blank cap.

To mount the Ethernet board or DeviceNet boards, remove the upper or the middle blank cap.

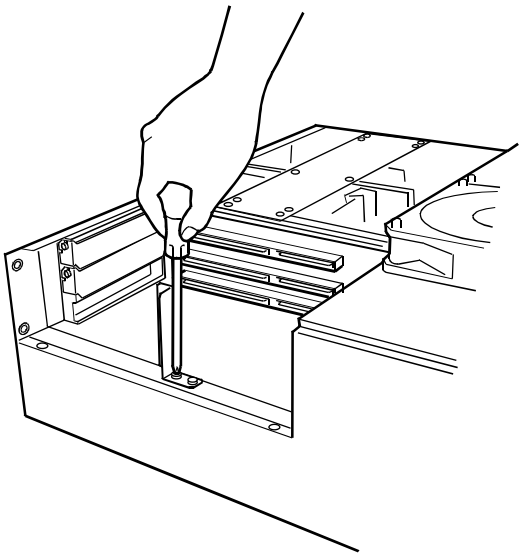


Step 6

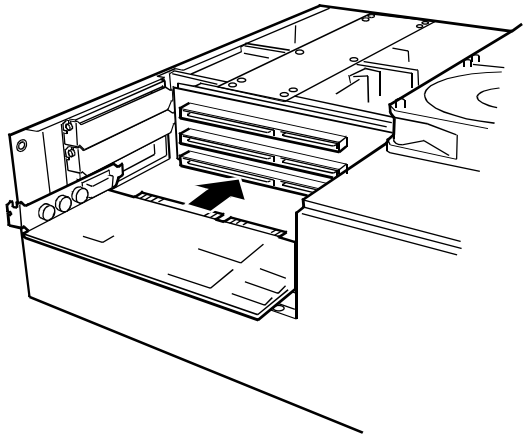
Required only for the robot controller (RC5-VM6A) designed for the VM-6070D.

To mount the μVision board to the robot controller (RC5-VM6A), remove the screws from the extension board retaining strut and take off the strut.

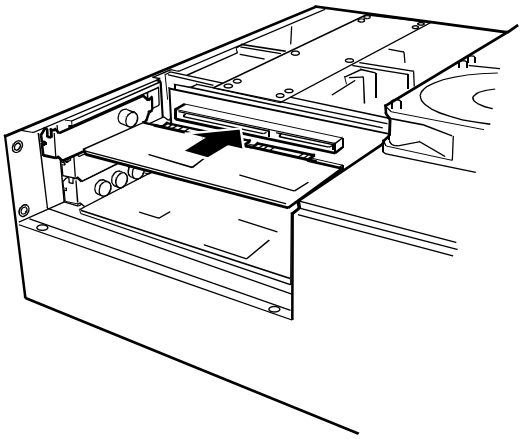
If you do not mount the μVision board, skip to Step 8.



Step 7 Fully insert the μVision board in the lower slot connector.

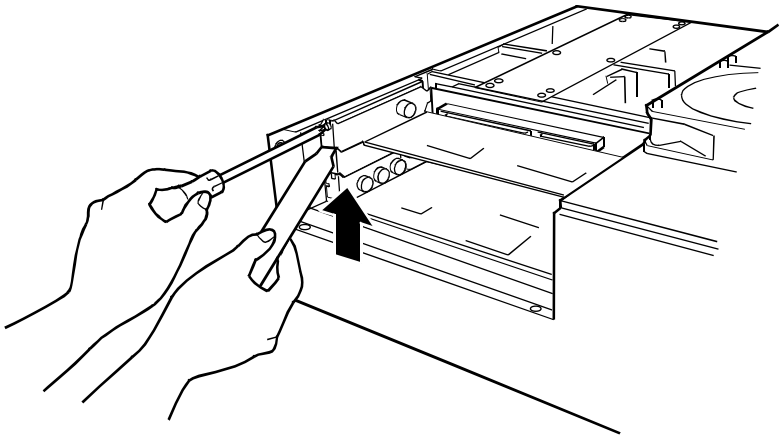


Step 8 Fully insert the Ethernet board or the DeviceNet board(s) into the upper or the middle slot connector.



Step 9

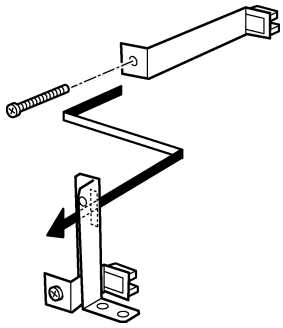
Using the removed panel hole blank cap, push up the panel of each extension board. Secure the extension board with the panel fastening screw.



Step 10

Secure the board support plate to the extension board strut.

Required only for the robot controller (RC5-VM6A) designed for the VM-6070D.

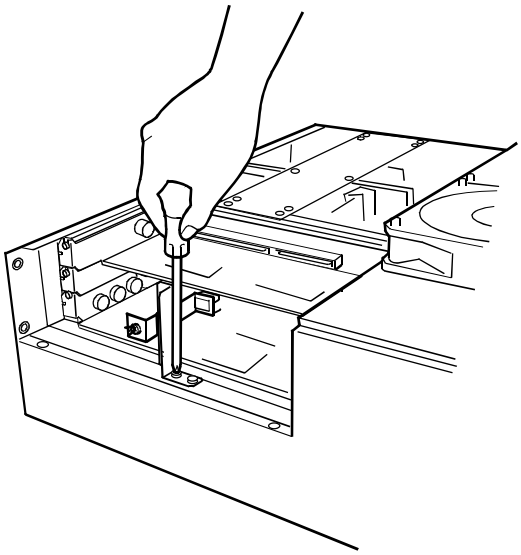


Step 11

Required only for the robot controller (RC5-VM6A) designed for the VM-6070D.

Set the assembled extension board strut back into place and tighten the screws.

Tightening torque: 0.69 Nm ±20%



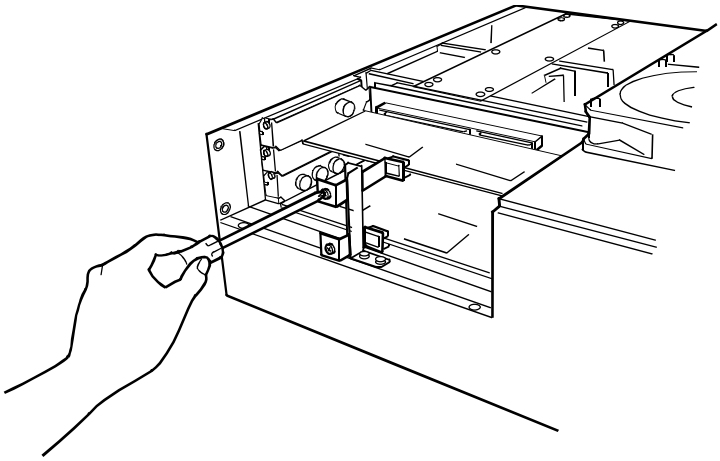
Step 12

Required only for the robot controller (RC5-VM6A) designed for the VM-6070D.

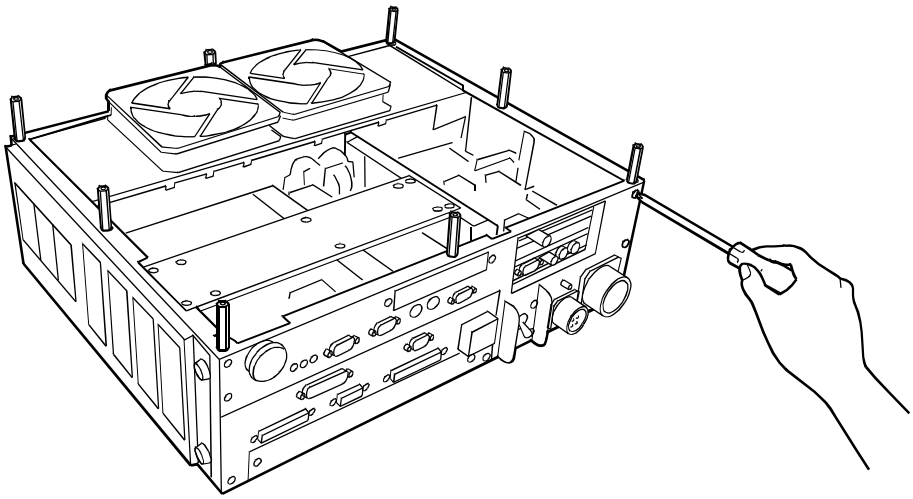
Adjust the position of each board support plate with the screw so that each extension board will be supported firmly.

When installing more than one extension board, be sure to tighten screws starting on the lower board.

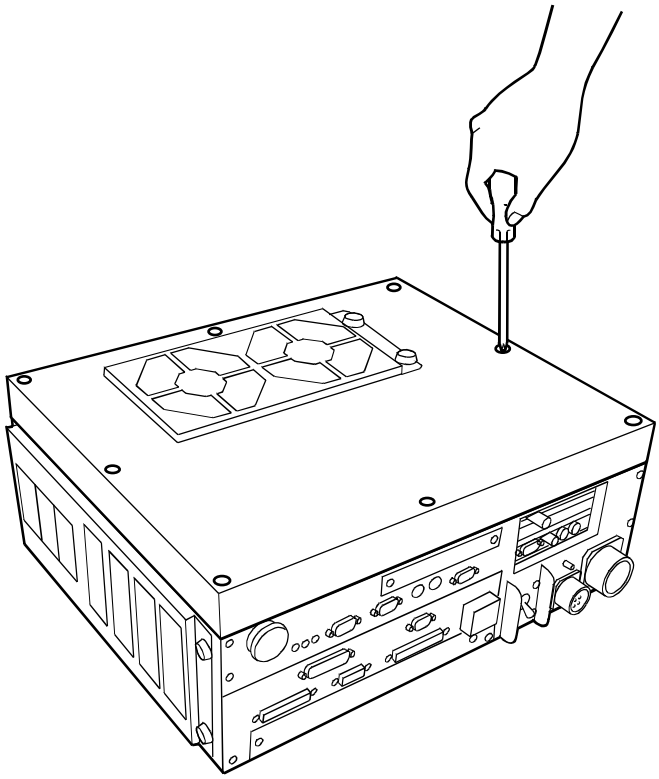
Tightening torque: 0.15 Nm ±20% for the lower slot
0.10 Nm ±20% for the middle slot
0.15 Nm ±20% for the higher slot



Step 13 Install the side plate and secure it with two screws.



Step 14 Put the top cover and secure it with eight screws.



The mounting of the extension boards is now finished.

PART 3 OTHER OPTIONS

Chapter13 Controller Protective Box

A controller protective box is an optional heat exchanger box to protect the robot controller from an undesirable environment (dust, oil mist) in plant. It has two kinds of models (FB-9, FB-10) for the variation of the controller external size.

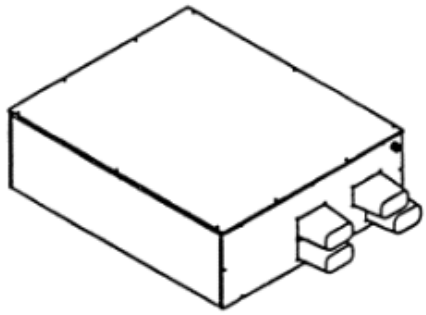
13.1 Models of Controller Protective Box

Models of controller protective box and applicable controllers are shown in the figure below.

Model	Applicable controllers (For RC5 type)
FB-9	For VM-D and HM-E series For extended-joints support controllers
FB-10	For VS-D/-E, VC-E, HS-E, H*-D and XYC-D series

13.2 Components in Package

Check that the following components are contained in the package of the controller protective box.

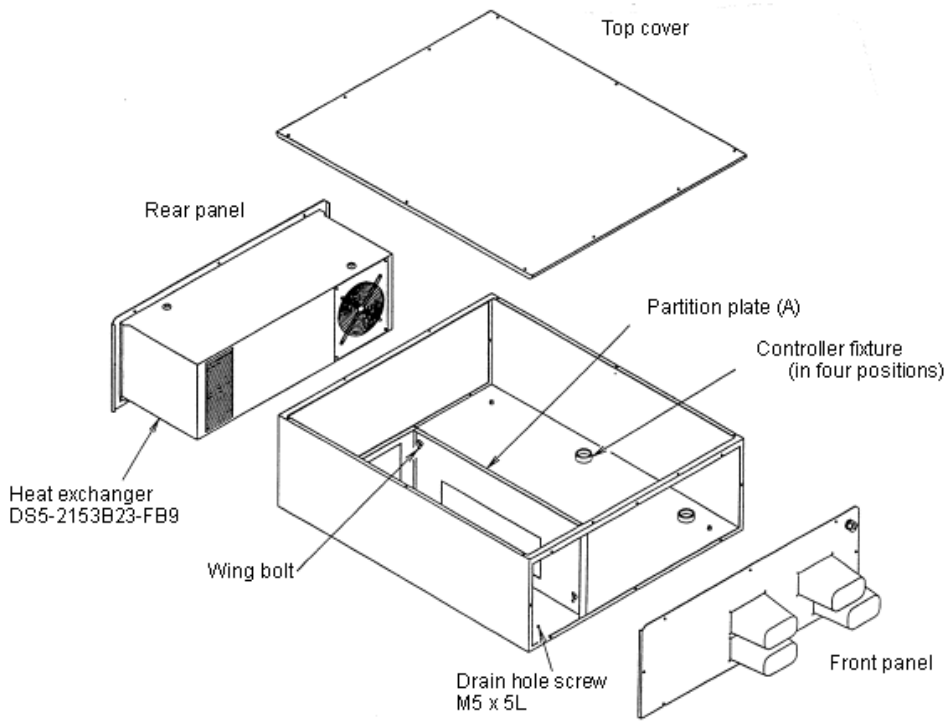
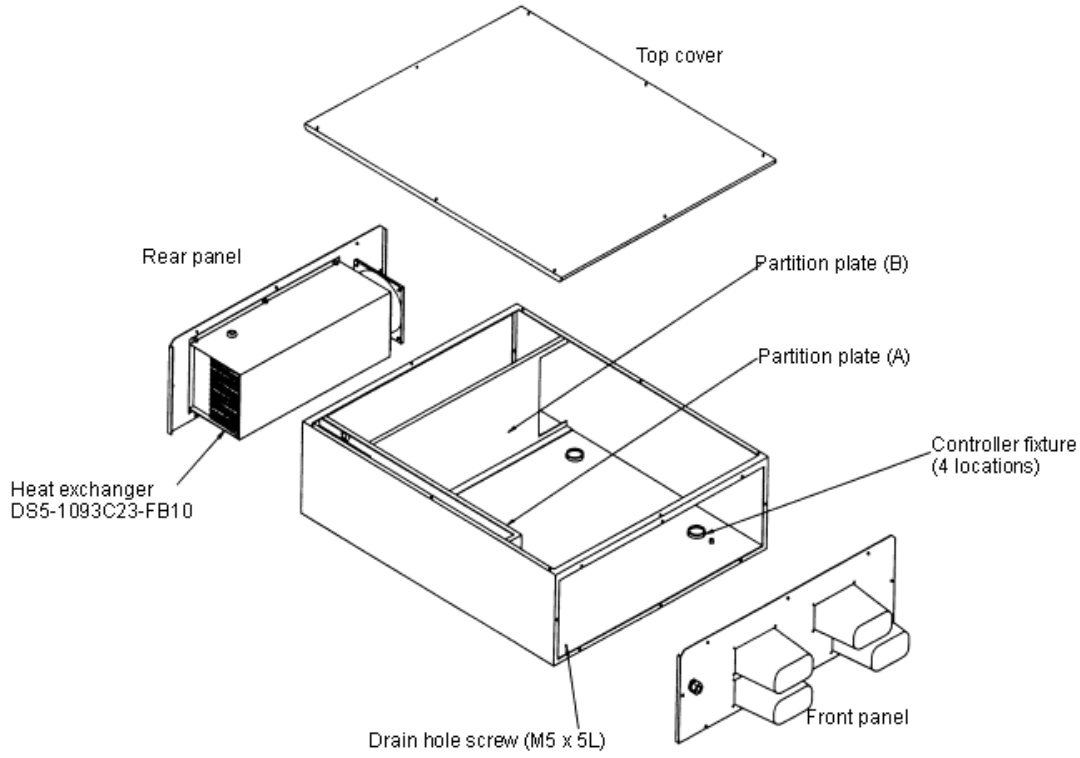


Controller protective box (1 pc)

Binding band (4 pcs)

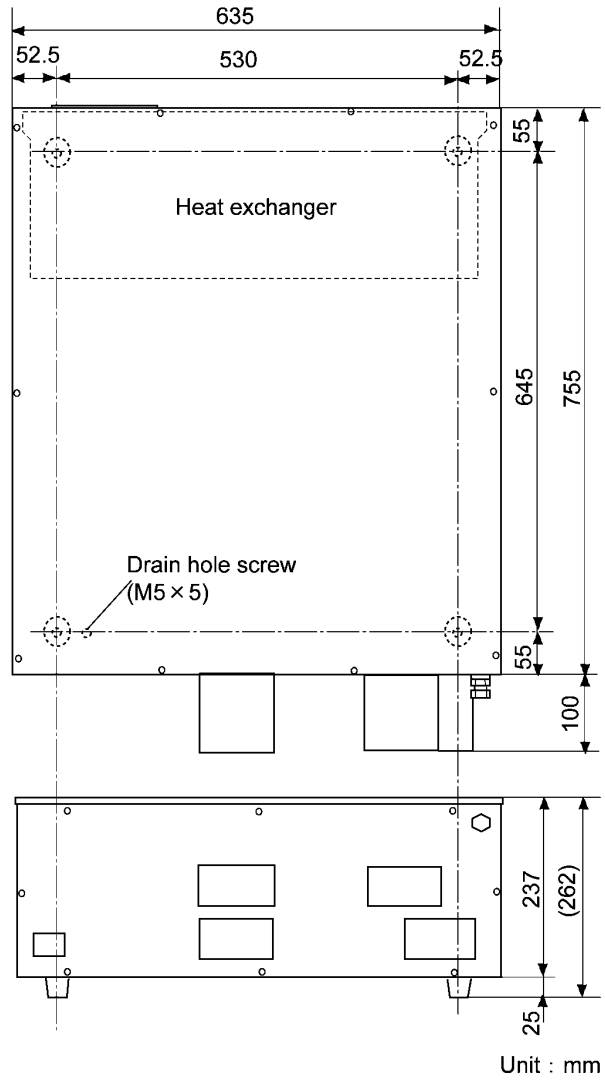
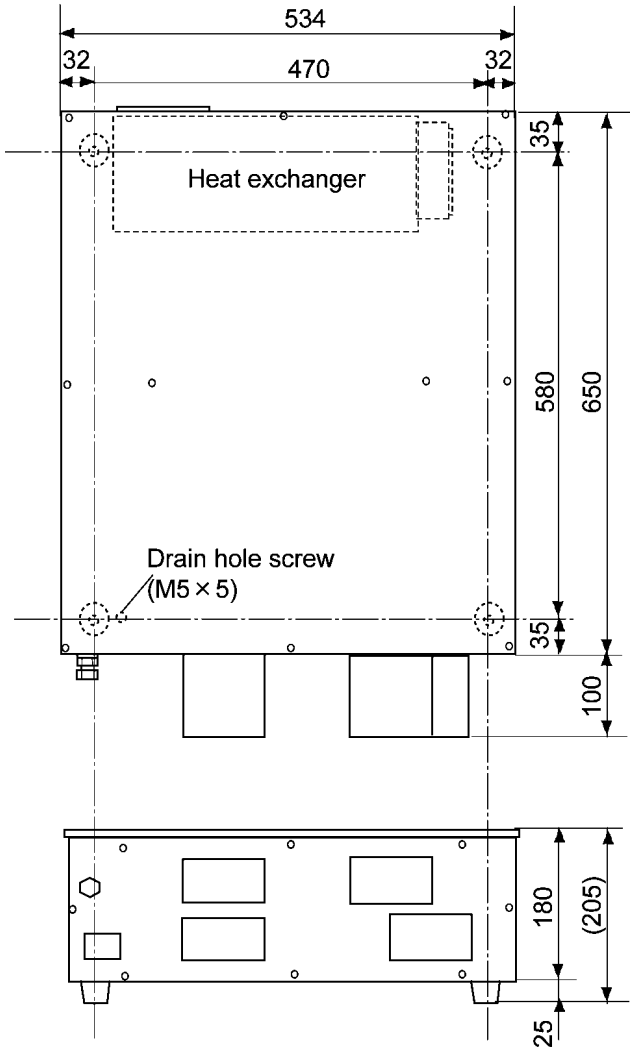
13.3 Names of the Components

The figure below shows the names of components.

Model	Names of components
FB-9	
FB-10	

13.4 External Dimensions

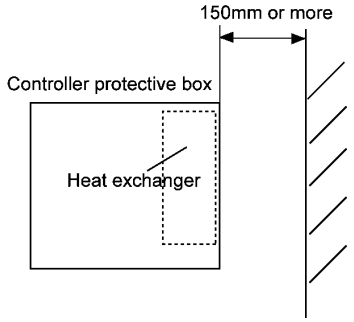
External dimensions of the controller protective box are shown in the figure below.

FB-9	FB-10
	

13.5 Setting up the Controller Protective Box

Placing the controller protective box

(1) Place the controller protective box on a flat, level plane.
(2) Do not place anything within 150 mm from the heat exchanger of the controller protective box.



Preparing a power supply

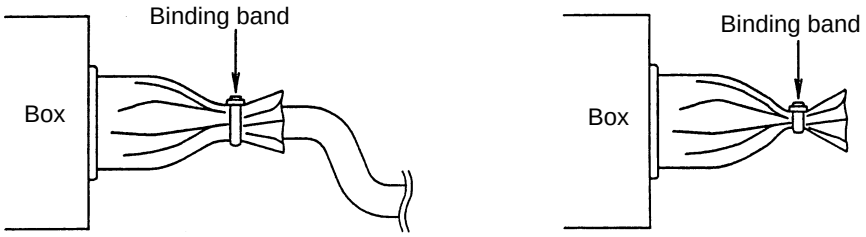
Make a single-phase 200 VAC power supply (86W for the FB-9, 35W for the FB-10) ready for use.
Connect the power supply to the fan motor drive terminal.
Recommended cable: 1.25 mm^2 x 3-core (outside diameter: 11 to 13 mm)

Note 1: Make the controller protective box share the same circuit breaker of the power supply (200 VAC) with the robot controller.
Note 2: Ground the controller protective box to prevent an electric shock.

Setting the robot controller into the protective box

(1) Remove the top cover from the controller protective box.
(2) For the VM-D controller protective box (FB-9), remove the wing bolt and take off the partition plate (A).
(3) Put the robot controller into the protective box so that its rubber feet will be fitted into the controller fixtures of the protective box.
(4) For the VM-D controller protective box (FB-9), secure the partition plate (A) with the wing bolt.
(5) Route the necessary cables through the ducts and connect them. As shown below, tie up each duct with an attached binding band.

Note: Tying up duct(s) not in use



Note: Tie up the opening of each duct not in use with an attached binding band to prevent entry of dust, water, etc. into the controller protective box.

13.6 Precautions

(1) The controller protective box is a dust-proof, splash-proof structure equivalent to JIS IP53.

The controller protective box is not explosion-proof and must not be installed in the following environments and locations to ensure safety:

- in an environment full of combustible gas, flammable liquid, etc;
- in an environment full of acid or alkali corrosive gas;
- in a location close to electric noise sources, such as large inverters, high-output high-frequency generators, large conductors and welders;
- in a location where the controller protective box will not be used outside the ambient temperature range from 0°C to 40°C;
- in a location where the controller protective box will be exposed to rain or dew;
- in an environment where the controller protective box will be exposed directly to water, oil or chips;
- in an environment where fine chips will be produced from cutting, etc;
- in an environment using oil not specified in this manual.
  (YUSHIRON OIL No. 4 is specified.)

(2) Seal the mounting face and screws of the controller protective box when using it in an environment full of oil mist. Otherwise oil mist may accumulate on the fin, resulting in a collection of oil. Periodically clean the controller protective box.

(3) If oil mist, etc. collects in the controller protective box, remove the drain hole screw and drain off the oil.

(4) The controller protective box is not equipped with a power switch. Use external means to turn the controller on or off.

(5) The controller protective box must be installed horizontally. Vertical installation will cause accidents.

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**-D/-E SERIES

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Factory Automation Division

11D**C

The purpose of this manual is to provide accurate information in the handling and operating of the robot. Please feel free to send your comments regarding any errors or omissions you may have found, or any suggestions you may have for generally improving the manual.

In no event will DENSO WAVE INCORPORATED be liable for any direct or indirect damages resulting from the application of the information in this manual.